Exhibit A

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Wang et al.

(10) **Patent No.: US 7,761,185 B2**
(45) **Date of Patent: Jul. 20, 2010**

(54) **REMOTE PRESENCE DISPLAY THROUGH REMOTELY CONTROLLED ROBOT**

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(73) Assignee: **InTouch Technologies, Inc.**, Goleta, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 960 days.

(21) Appl. No.: **11/542,912**

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US 2008/0082211 A1 Apr. 3, 2008

(51) **Int. Cl.**
G05B 15/00 (2006.01)

(52) **U.S. Cl.** **700/259**

(58) **Field of Classification Search** 700/245, 700/248–249, 257, 259; 901/1, 46–47
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995	A	7/1974	Aghnides
4,413,693	A	11/1983	Derby
4,471,354	A	9/1984	Smith
4,519,466	A	5/1985	Shiraishi
4,638,445	A	1/1987	Mattaboni
4,733,737	A	3/1988	Falamak
4,875,172	A	10/1989	Kanayama
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,186,270	A	2/1993	West
5,305,427	A	4/1994	Nagata
5,341,242	A	8/1994	Gilboa et al.
5,341,854	A	8/1994	Zezulka et al.
5,374,879	A	12/1994	Pin et al.
5,419,008	A	5/1995	West
5,486,853	A	1/1996	Baxter et al.
5,510,832	A	4/1996	Garcia
5,544,649	A	8/1996	David et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2289697	A1	11/1998

(Continued)

OTHER PUBLICATIONS

Baltus et al., "Towards Personal Service Robots for the Elderly", Computer Science and Robotoics.

(Continued)

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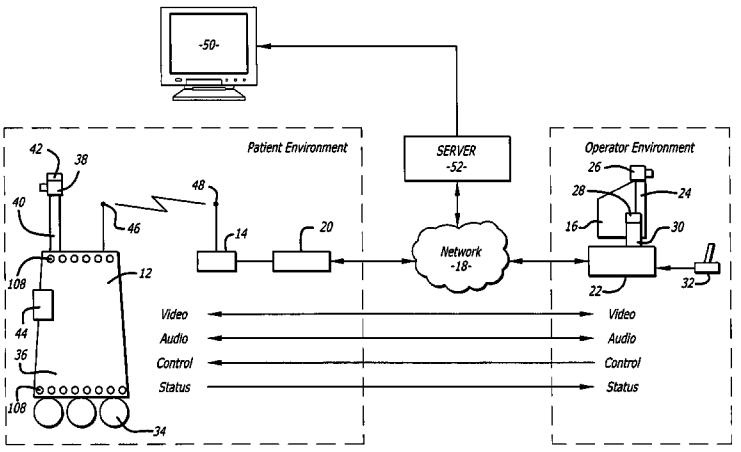
(57) **ABSTRACT**

A robot system that includes a robot and a remote station. The robot and remote station contain monitors, cameras, speakers and microphones that allow for two-way videoconferencing between a physician at the remote station and a patient in the vicinity of the robot. The system also includes a patient monitor that displays patient information such as an x-ray. The patient monitor can be seen by the patient, and by the physician through the robot camera. The system allows for a physician to remotely review the medical information with the patient.

13 Claims, 8 Drawing Sheets



U.S. PATENT DOCUMENTS

5,572,229	A	11/1996	Fisher	
5,630,566	A	5/1997	Case	
5,636,218	A	6/1997	Ishikawa et al.	
5,762,458	A	6/1998	Wang et al.	
5,786,846	A	7/1998	Hiroaki	
5,802,494	A	9/1998	Kuno	
5,838,575	A	11/1998	Lion	
5,857,534	A	1/1999	DeValult et al.	
5,917,958	A	6/1999	Nunally et al.	
5,959,423	A	9/1999	Nakanishi et al.	
5,966,130	A	10/1999	Benman, Jr.	
6,006,946	A	12/1999	Williams et al.	
6,036,812	A	3/2000	Williams et al.	
6,133,944	A	10/2000	Braun et al.	
6,135,228	A	10/2000	Asada et al.	
6,170,929	B1	1/2001	Wilson et al.	
6,211,903	B1	4/2001	Bullister	
6,219,587	B1	4/2001	Ahlin et al.	
6,232,735	B1	5/2001	Baba et al.	
6,233,735	B1	5/2001	Ebihara	
6,259,806	B1	7/2001	Green	
6,292,713	B1	9/2001	Jouppi et al.	
6,304,050	B1	10/2001	Skaar et al.	
6,346,950	B1	2/2002	Jouppi	
6,369,847	B1	4/2002	James et al.	
6,430,471	B1	8/2002	Kintou et al.	
6,438,457	B1	8/2002	Yokoo et al.	
6,463,361	B1	10/2002	Wang et al.	
6,474,434	B1	11/2002	Bech	
6,491,701	B2	12/2002	Tierney et al.	
6,496,099	B2	12/2002	Wang et al.	
6,522,906	B1	2/2003	Salisbury et al.	
6,532,404	B2	3/2003	Colens	
6,535,182	B2	3/2003	Stanton	
6,535,793	B2	3/2003	Allard	
6,543,899	B2	4/2003	Covannon et al.	
6,549,215	B2	4/2003	Jouppi	
6,587,750	B2	7/2003	Gerbi et al.	
6,594,552	B1	7/2003	Nowlin et al.	
6,646,677	B2	11/2003	Noro et al.	
6,684,129	B2	1/2004	Salisbury et al.	
6,799,065	B1	9/2004	Niemeyer	
6,799,088	B2	9/2004	Wang et al.	
6,804,656	B1	10/2004	Rosenfeld et al.	
6,836,703	B2	12/2004	Wang et al.	
6,839,612	B2	1/2005	Sanchez et al.	
6,852,107	B2	2/2005	Wang et al.	
6,871,117	B2	3/2005	Wang et al.	
6,879,879	B2	4/2005	Jouppi et al.	
6,892,112	B2	5/2005	Wang et al.	
6,925,357	B2	8/2005	Wang et al.	
6,995,664	B1	2/2006	Darling	
2001/0037163	A1	11/2001	Allard	
2001/0054071	A1	12/2001	Loeb	
2002/0027597	A1	3/2002	Sachau	
2002/0057279	A1	5/2002	Jouppi	
2002/0058929	A1	5/2002	Green	
2002/0063726	A1	5/2002	Jouppi	
2002/0120362	A1	8/2002	Lathan et al.	
2002/0130950	A1	9/2002	James et al.	
2002/0141595	A1	10/2002	Jouppi	
2002/0183894	A1	12/2002	Wang et al.	
2003/0048481	A1	3/2003	Kobayashi	
2003/0050733	A1	3/2003	Wang et al.	
2003/0100892	A1	5/2003	Morley et al.	
2003/0114962	A1	6/2003	Niemeyer	
2003/0135203	A1	7/2003	Wang et al.	
2003/0144649	A1	7/2003	Ghodoussi et al.	
2003/0151658	A1	8/2003	Smith	
2003/0220541	A1	11/2003	Salisbury et al.	
2004/0019406	A1	1/2004	Wang et al.	
2004/0117065	A1	6/2004	Wang et al.	
2004/0143421	A1	7/2004	Wang et al.	
2004/0162637	A1	8/2004	Wang et al.	
2004/0167666	A1	8/2004	Wang et al.	
2004/0167668	A1	8/2004	Wang et al.	
2004/0174129	A1	9/2004	Wang et al.	
2005/0021182	A1	1/2005	Wang et al.	
2005/0021183	A1	1/2005	Wang et al.	
2005/0021187	A1	1/2005	Wang et al.	
2005/0024485	A1	2/2005	Castles et al.	
2005/0028221	A1	2/2005	Liu et al.	
2005/0035862	A1	2/2005	Wildman et al.	
2005/0038416	A1	2/2005	Wang et al.	
2005/0052527	A1	3/2005	Remy et al.	
2005/0204438	A1 *	9/2005	Wang et al.	901/1
2006/0047365	A1	3/2006	Ghodoussi et al.	
2006/0064212	A1	3/2006	Thorne	

FOREIGN PATENT DOCUMENTS

EP	0981905	B1	1/2002
JP	07257422	A	10/1995
JP	2000-032319	A	1/2000
JP	2002-046088		2/2002
JP	2002305743	A	10/2002

OTHER PUBLICATIONS

Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", Jun. 2003.

Breslow, Michael J., MD et al., "Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcome: An alternative paradigm for intensivist staffing", Critical Care Med, Jan. 2004, vol. 32, No. 1, pp. 31-38.

Celi et al., "The eICU: It's not just telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001.

Cleary et al., "State of the art in surgical robotics: Clinical applications and technology challenges", 2002 Internet, pp. 1-26.

CNN.com/Technology, Paging R.Robot: Machine helps doctors with patients, Sep. 30, 2003, Internet, 1-3.

Davies, "Robotics in Minimally Invasive Surgery", 1995, Internet, pp. 5/1-5/2.

DiGiorgio, James, "Is Your Emergency Department of the 'Leading Edge'?", 2005, Internet, pp. 1-4.

Elhajj et al., "Supermedia in Internet-based telerobotic operations", 2001, Internet, p. 1-14.

Ellison et al., "Telerounding and Patient Satisfaction Following Surgery".

Goldman, Lea, "Machine Dreams", Entrepreneurs, Forbes, May 27, 2002.

Gump, Michael D., "Robot Technology Improves VA Pharmacies", 2001, Internet, pp. 1-3.

Harmo et al., "Moving Eye—Interactive Telepresence Over Internet With a Ball Shaped Mobile Robot", 2000.

Hees, William P., "Communications Design for a Remote Presence Robot", Jan. 14, 2002.

Ishihara, Ken et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", 1991, IEEE/RSJ, pp. 1145-1150, vol. 2.

Jouppi, et al., :Mutually-Immersive Audio Telepresence, Audio Engineering Society Convention Paper, presented at 113th Convention Oct. 2002.

Jouppi, Norman P., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Nov. 16-20, 2002, New Orleans LA.

Kanehiro, Fumio et al., Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting, 2001,IEEE, pp. 3217-3276.

Kaplan et al., "An Internet Accessible Telepresence".

Kuzuoka et al., "Can the GestureCam Be a Surrogate?"

Lim, Hun-ok et al., Control to Realize Human-like Walking of a Biped Humanoid Robot, IEE 2000, pp. 3271-3276.

Loeb, Gerald, "Virtual Visit: Improving Communication for Those Who Need It Most", 2001.

Mack, "Minimally invasive and robotic surgery", 2001, Internet IEEE, pp. 568-572.

Magne Charge—Smart Power for Electric Vehicles, Internet, Jun. 27, 2002.

Martin, Anya, "Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.

McCardle et al., "The challenge of utilizing new technology in design education", 2000 Internet, pp. 122-127.

Ojha, Anad, "An application of Virtual Reality in Rehabilitation", Jan. 1994, IEEE, pp. 4-6.

Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", http://vive.cs.berkeley.edu/capek, 1995.

Paulos, Eric John, "Personal Tele-Embodiment", 2001.

Paulos, et al. , "Ubiquitous Tele-embodiment: Applications and Implications", International Journal of Human Computer Studies, Jun. 1997, vol. 46, No. 6, pp. 861-877.

Paulos, et al., "Designing Personal Tele-Embodiment", Presented at the IEEE International Conference on Robotics and Animation, Leuven, Belgium, May 20, 1998.

Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE, vol. 10, No. 4, Aug. 1994.

Robot Hardware Mobile Robotics Research Group, Edinburgh, "Mobile Robotics Research Group", 2000 Internet, pp. 1-2.

Roland Piquepaille's Technology Trends, "How new technologies are modifying your way of life", 2003, Internet, pp. 1-2.

PYXIS HelpMate®, the Trackless Robotic Courier, Internet, 3 pgs.

"Remote Presence", p. 131-147.

Roy et al., "Towards Personal Service Robots for the Elderly", Internet, Mar. 7, 2002.

Sandt, Frederic et al., "Perceptions for a Transport Robot in Public Environments", 1997, IROS '97.

Stephenson, Gary, "Dr. Robot Tested at Hopkins", 2003, Internet, p. 1.

Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Dec. 2002, Internet, 1-17.

Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", 1997, IEEE, pp. 2771-2776.

Thrun et al, "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", 2000, Internet pp. 1-35.

Tzafestas, et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", 2000, Internet, pp. 1-23.

Urquhart, Kim, "InTouch's robotic Companion 'beams up' healthcare experts", Medical Device Daily, vol. 7, No. 39, Feb. 27, 2003, p. 1, 4.

Zipperer, Lorri, "Robotic dispensing system", 1999, Internet, pp. 1-2.

Zorn, Benjamin G., "Ubiquitous Telepresence", http://www.cs.colorado.edu/~zorn/ut/vision/vision.html, Mar. 5, 1996.

* cited by examiner

FIG. 1

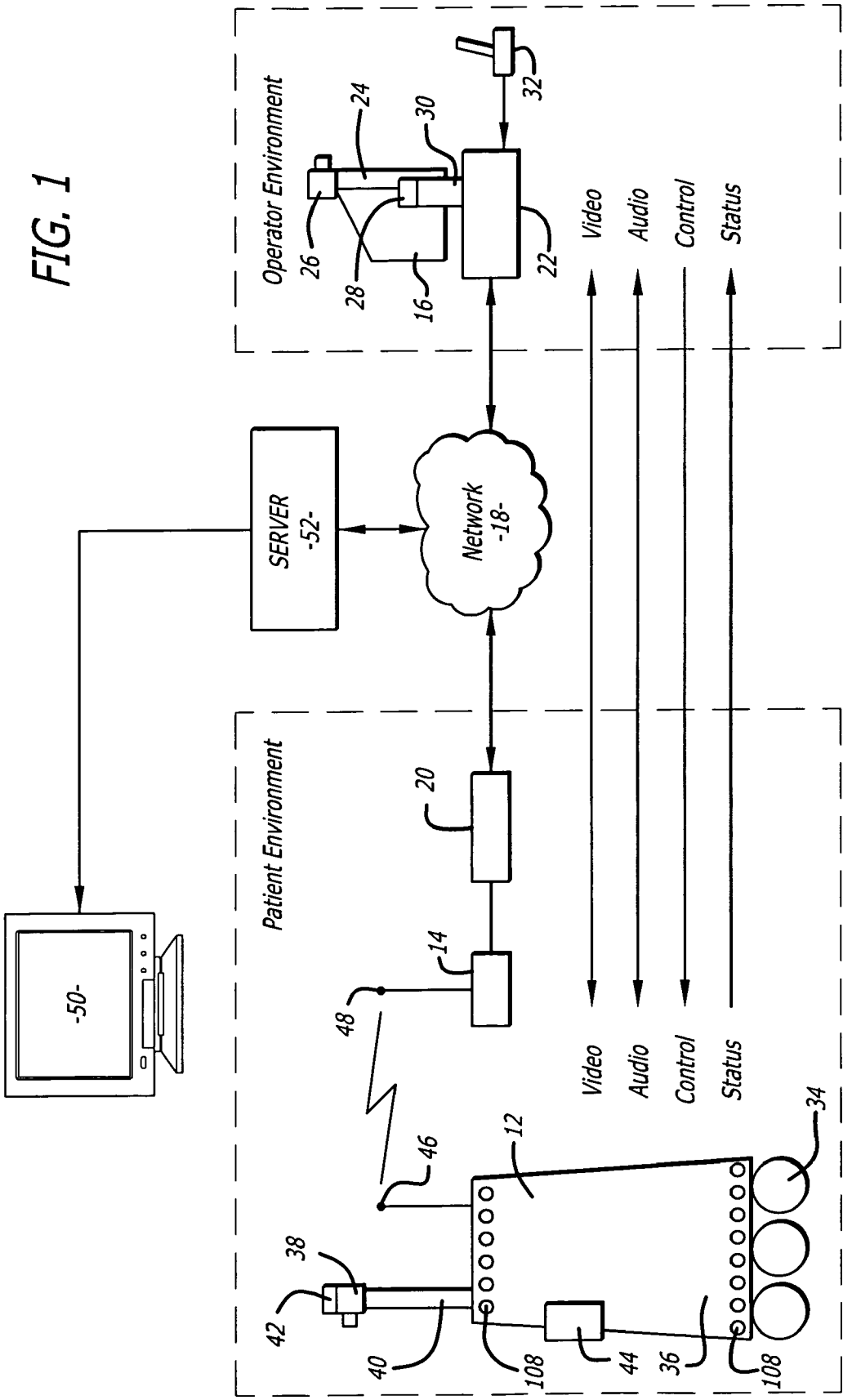
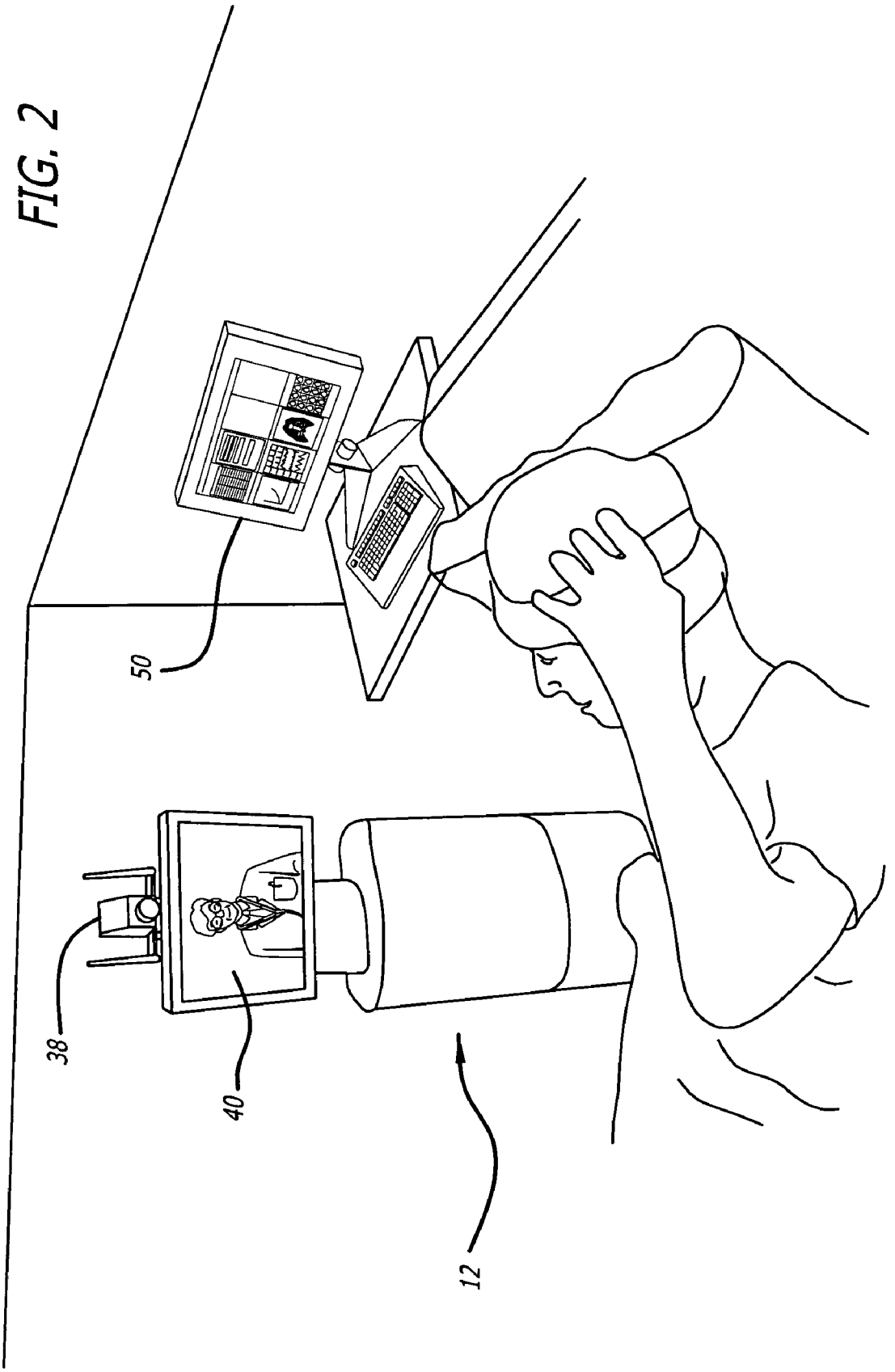

Operator Environment
Patient Environment
Network
-18-
SERVER
-52-
-50-
Video
Audio
Control
Status
Video
Audio
Control
Status
16
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
108
108
12
14

FIG. 2



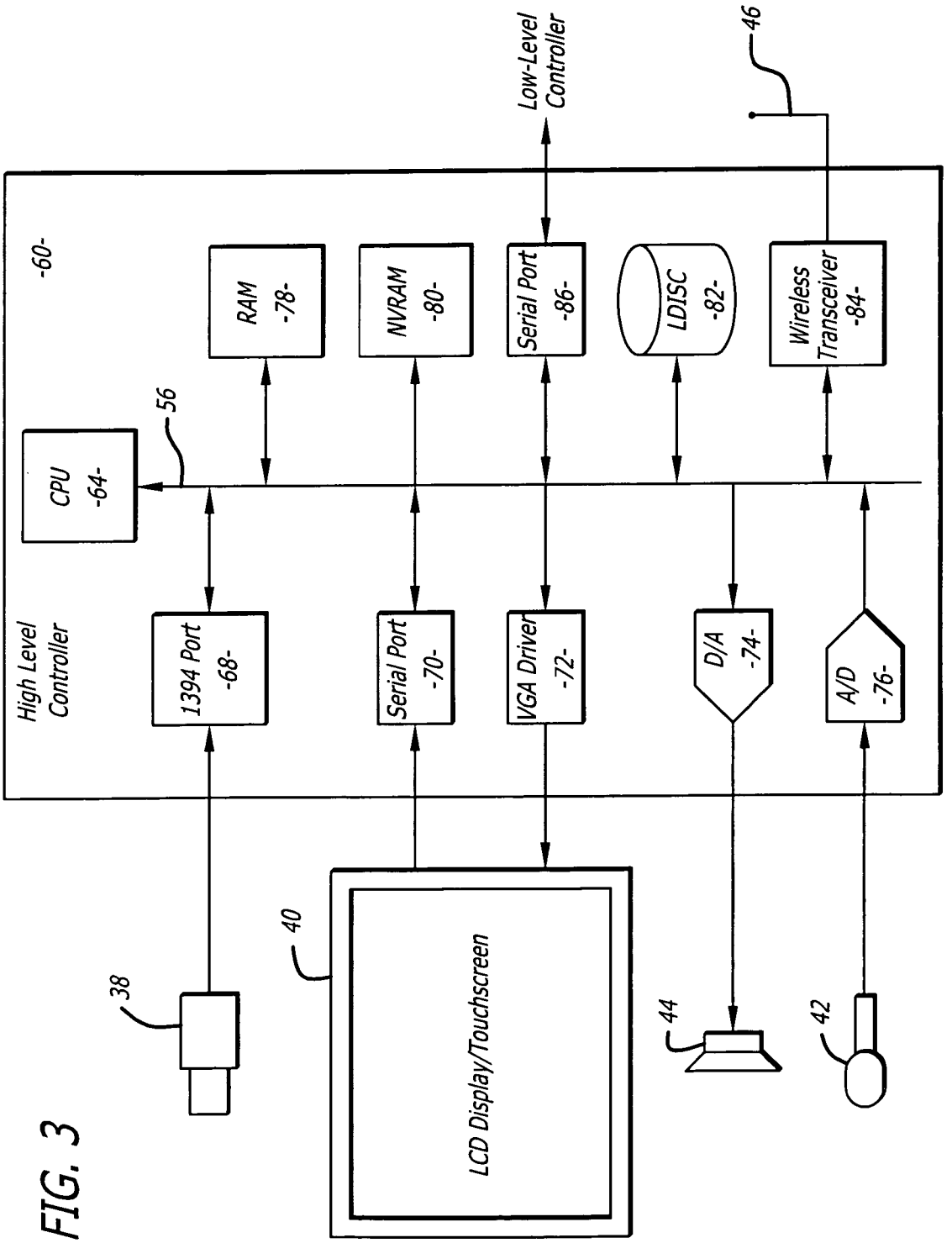

Low-Level Controller
46
-60-
RAM -78-
NVRAM -80-
Serial Port -86-
LDISC -82-
Wireless Transceiver -84-
56
CPU -64-
High Level Controller
1394 Port -68-
Serial Port -70-
VGA Driver -72-
D/A -74-
A/D -76-
38
40
LCD Display/Touchscreen
44
42

FIG. 3

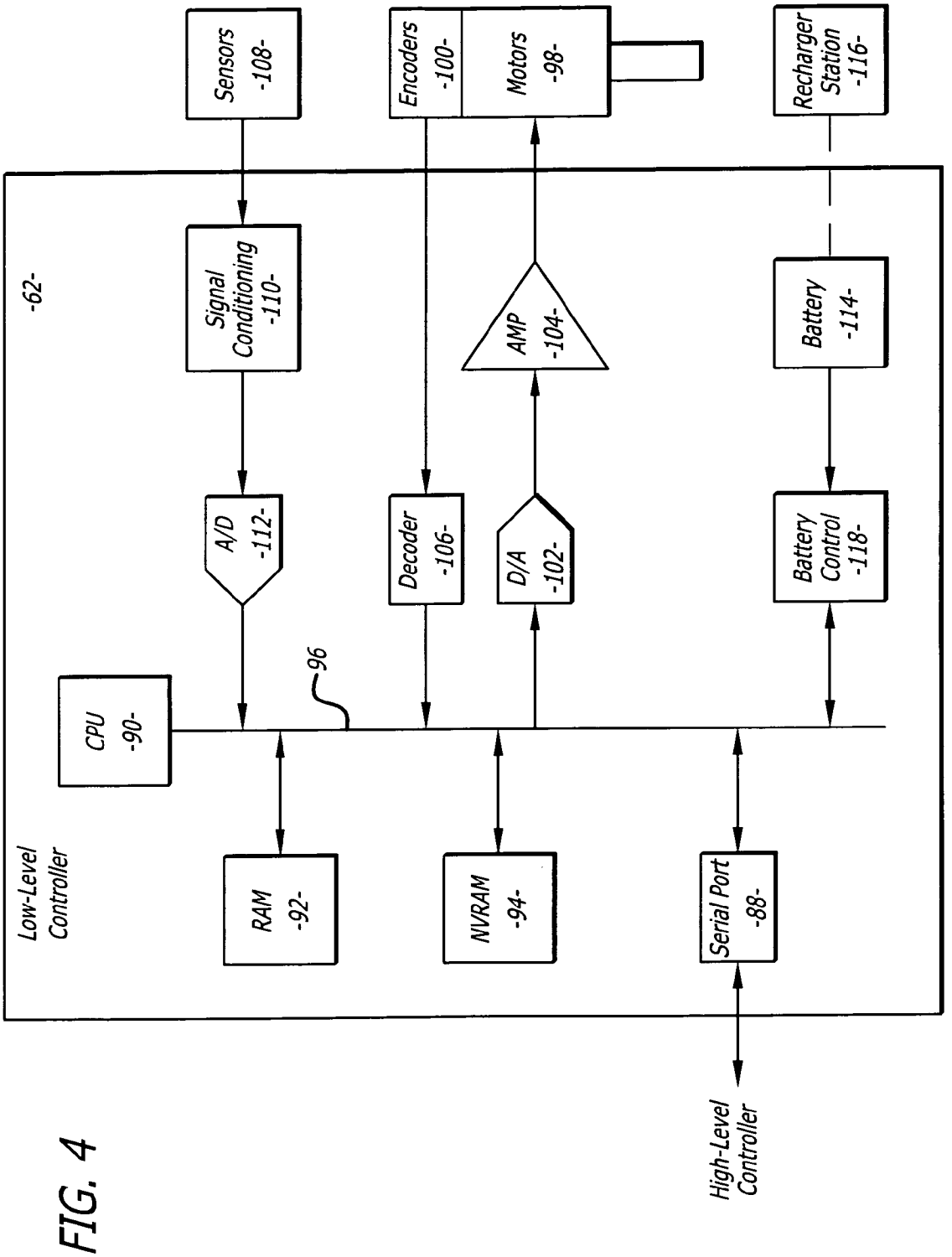

Sensors -108-
Encoders -100-
Motors -98-
Recharger Station -116-
-62-
Signal Conditioning -110-
AMP -104-
Battery -114-
A/D -112-
Decoder -106-
D/A -102-
Battery Control -118-
96
CPU -90-
Low-Level Controller
RAM -92-
NVRAM -94-
Serial Port -88-
High-Level Controller

FIG. 4

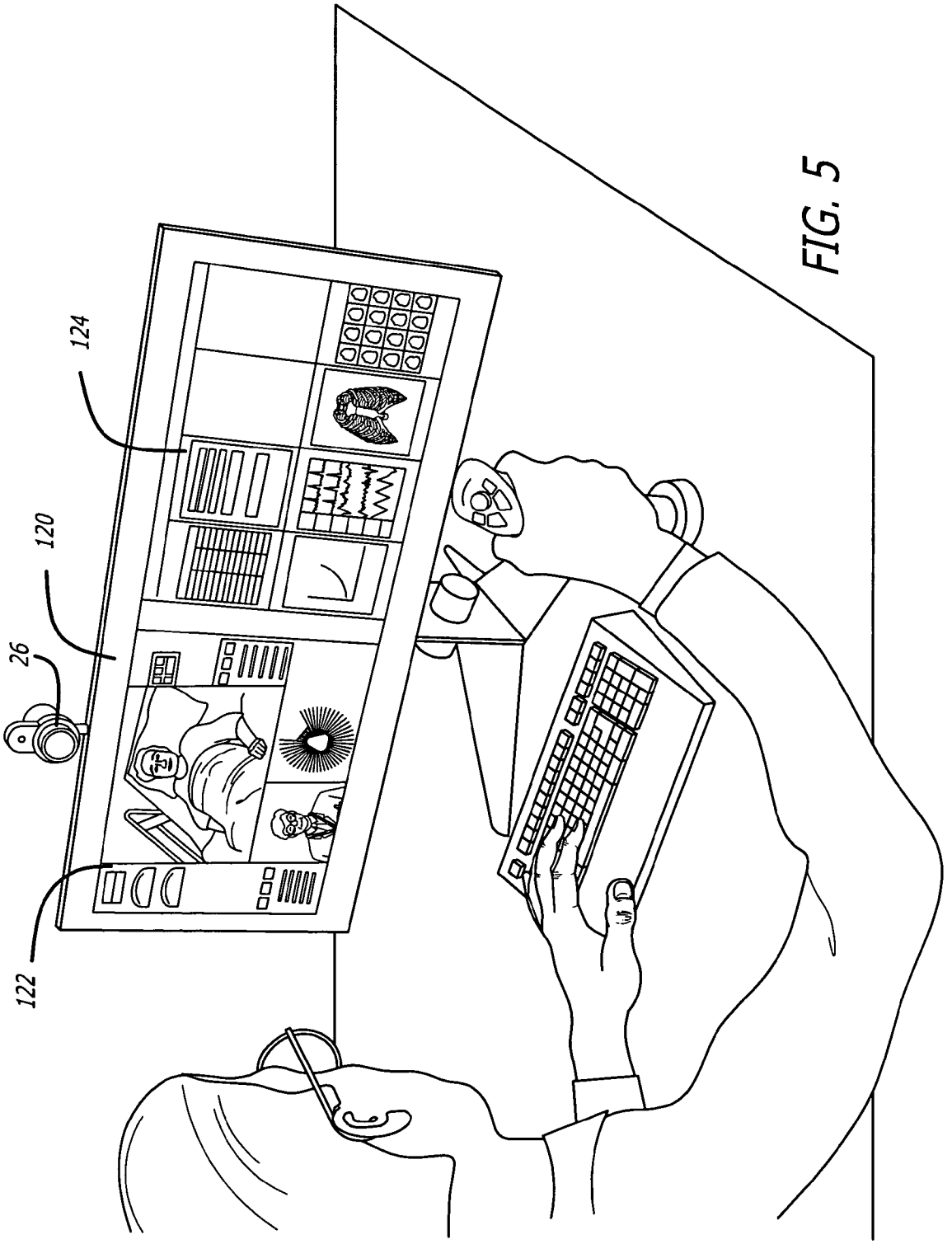


FIG. 5

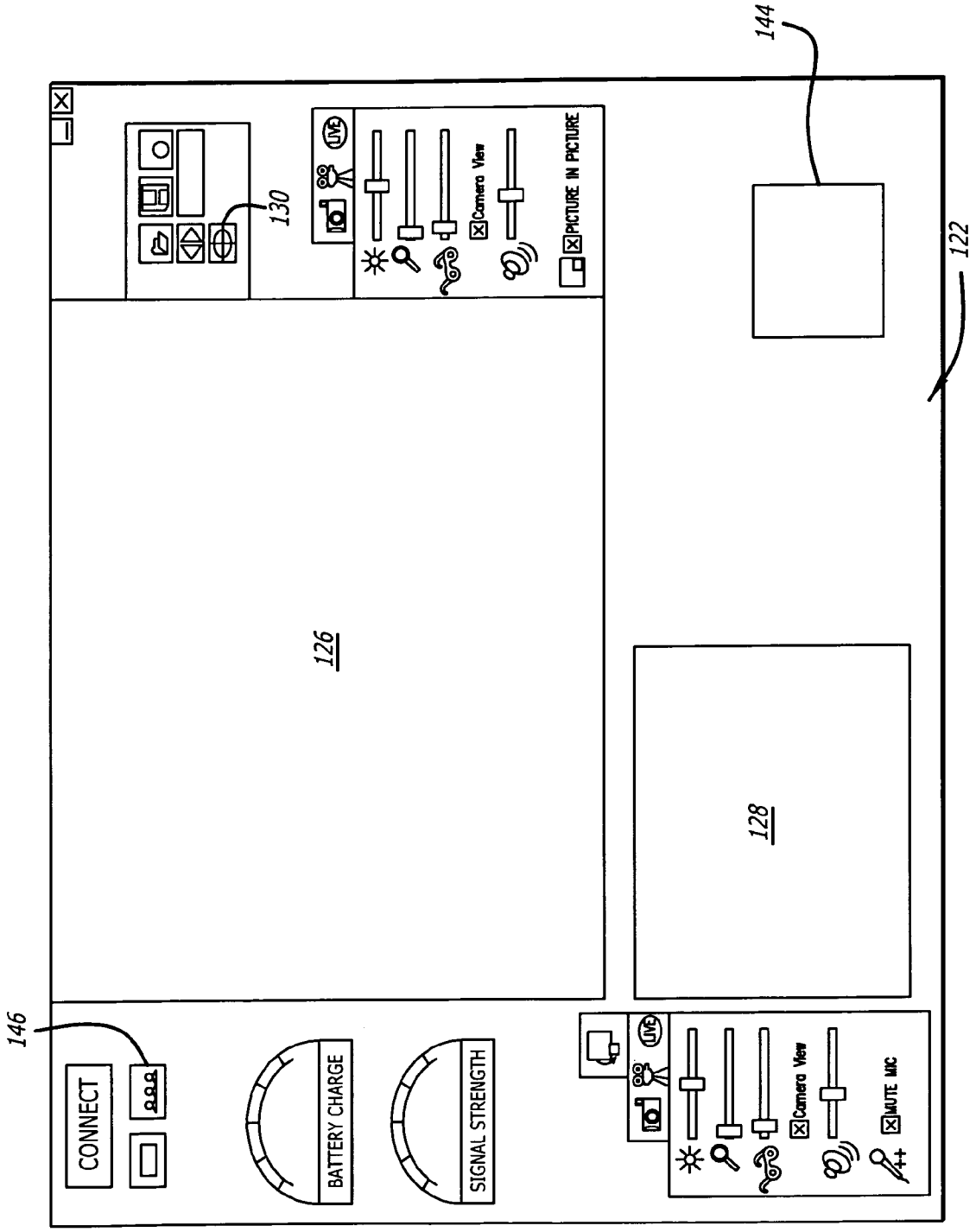

144
122
130
Camera View
PICTURE IN PICTURE
126
128
146
CONNECT
BATTERY CHARGE
SIGNAL STRENGTH
Camera View
MUTE MIC

FIG. 6

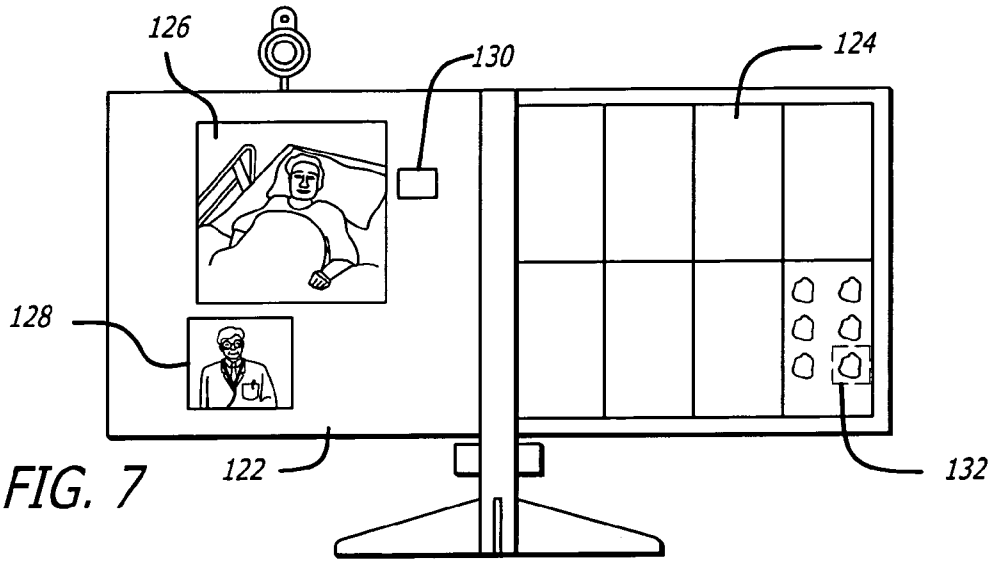


FIG. 7

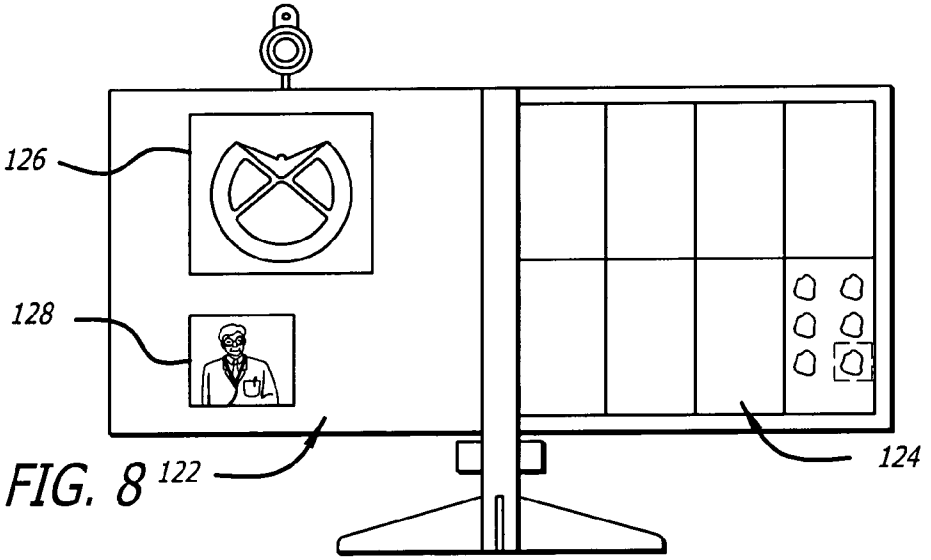


FIG. 8

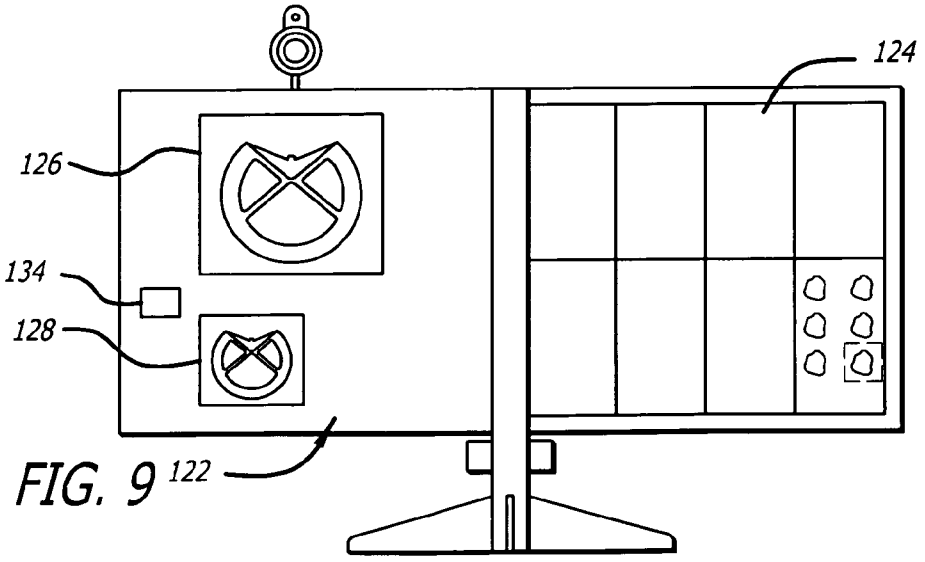


FIG. 9

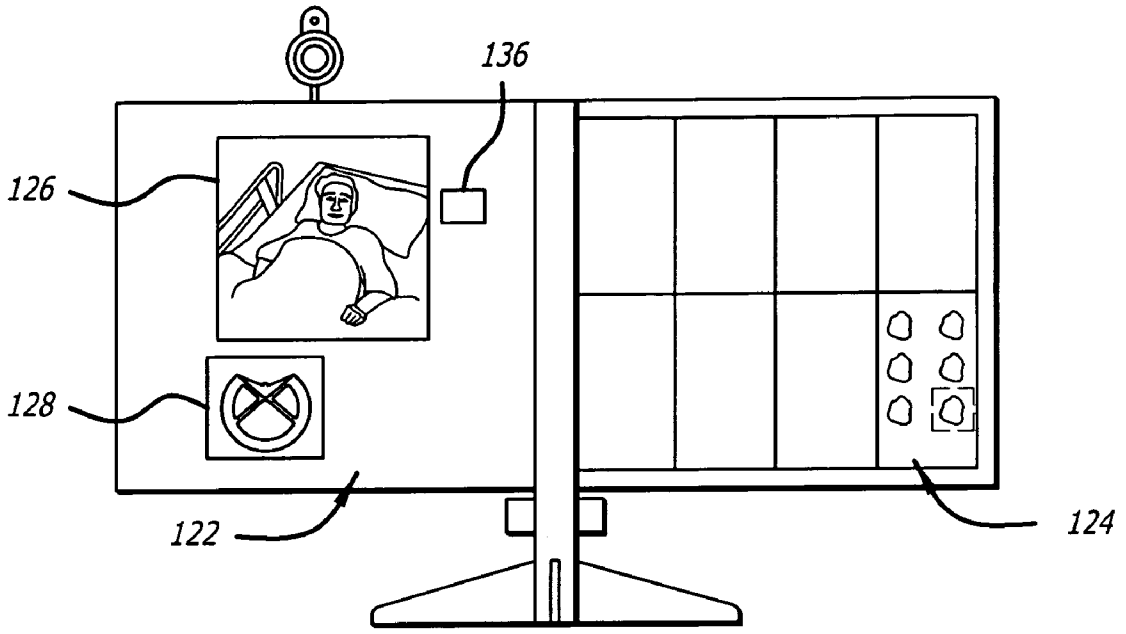


FIG. 10

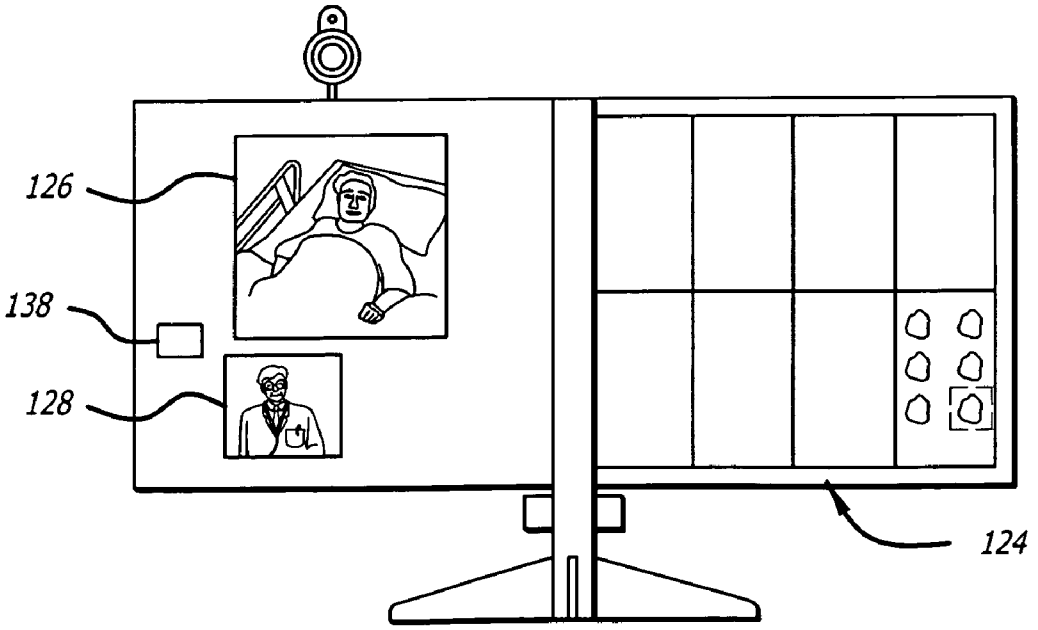


FIG. 11

REMOTE PRESENCE DISPLAY THROUGH REMOTELY CONTROLLED ROBOT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to a system and method to provide patient consultation by a physician.

2. Background Information

There has been marketed a mobile robot introduced by InTouch-Health, Inc., the assignee of this application, under the trademarks COMPANION, RP-6 and RP-7. The InTouch robot is controlled by a user at a remote station. The remote station may be a personal computer with a joystick that allows the user to remotely control the movement of the robot. Both the robot and remote station have cameras, monitors, speakers and microphones to allow for two-way video/audio communication.

The InTouch robot has been used by physicians to remotely view and communicate with patients in healthcare facilities. The robot monitor displays an image of the doctor to create a tele-presence of the physician. A doctor can move the robot from room to room of the facility to provide consultation and care for the patient. The cameras, monitors, speakers and microphones of the robot and remote station allow the physician to communicate with the patient through speech and visual images.

It is sometimes desirable to review medical information with the patient. For example, it may be desirable to review an x-ray with a patient while providing consultation through the tele-presence robot. The medical information can be provided to the patient by a medical assistant who is present at the remote patient location. This requires that the assistant be present in the room. Alternatively, the robot monitor can display the medical information. Unfortunately, when the information is displayed by the robot monitor the physican's video image is no longer displayed and the robot does not provide a tele-presence of the doctor. It would be desirable to provide a system that allows a mobile robot to project a presence of a physician while reviewing medical information of a patient without requiring a medical assistant.

BRIEF SUMMARY OF THE INVENTION

A robot system that includes a remote station coupled to a mobile robot. The mobile robot has a robot monitor that displays an image captured by a remote station camera. Likewise, the remote station has a monitor that displays an image captured by a robot camera. The system further includes a patient monitor that displays patient information that can be captured by the robot camera.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a robotic system;

FIG. **2** is an illustration of the robotic system being used to provide physician consultation to a patient;

FIG. **3** is a schematic of an electrical system of a robot;

FIG. **4** is a further schematic of the electrical system of the robot;

FIG. **5** is a display user interface of a remote station having a first screen field and a second screen field;

FIG. **6** is a display user interface showing a first screen field;

FIG. **7** is a display user interface showing a portion of the second screen field being highlighted;

FIG. **8** is a display user interface showing the highlighted portion of the second screen transferred to the first screen;

FIG. **9** is a display user interface showing the highlighted portion of the screen shared with the robot monitor;

FIG. **10** is a display user interface showing a live robot camera feed;

FIG. **11** is a display user interface showing a live remote station camera feed.

DETAILED DESCRIPTION

Disclosed is a robot system that includes a robot and a remote station. The robot and remote station contain monitors, cameras, speakers and microphones that allow for two-way videoconferencing between a physician at the remote station and a patient in the vicinity of the robot. The system also includes a patient monitor that displays patient information such as an x-ray. The patient monitor can be seen by the patient, and by the physician through the robot camera. The system allows for a physician to remotely review the medical information with the patient.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a system **10**. The robotic system includes a robot **12**, a base station **14** and a remote control station **16**. The remote control station **16** may be coupled to the base station **14** through a network **18**. By way of example, the network **18** may be either a packet switched network such as the Internet, or a circuit switched network such has a Public Switched Telephone Network (PSTN) or other broadband system. The base station **14** may be coupled to the network **18** by a modem **20** or other broadband network interface device. By way of example, the base station **14** may be a wireless router. Alternatively, the robot **12** may have a direct connection to the network thru for example a satellite.

The remote control station **16** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **16** is typically located in a place that is remote from the robot **12**. Although only one remote control station **16** is shown, the system **10** may include a plurality of remote stations. In general any number of robots **12** may be controlled by any number of remote stations **16** or other robots **12**. For example, one remote station **16** may be coupled to a plurality of robots **12**, or one robot **12** may be coupled to a plurality of remote stations **16**, or a plurality of robots **12**.

Each robot **12** includes a movement platform **34** that is attached to a robot housing **36**. Also attached to the robot housing **36** are a camera **38**, a monitor **40**, a microphone(s) **42** and a speaker(s) **44**. The microphone **42** and speaker **30** may create a stereophonic sound. The robot **12** may also have an antenna **46** that is wirelessly coupled to an antenna **48** of the base station **14**. The system **10** allows a user at the remote control station **16** to move the robot **12** through operation of the input device **32**. The robot camera **38** is coupled to the remote monitor **24** so that a user at the remote station **16** can view a patient. Likewise, the robot monitor **40** is coupled to the remote camera **26** so that the patient may view the user. The microphones **28** and **42**, and speakers **30** and **44**, allow for audible communication between the patient and the user. The monitor **40** and camera **38** may move together in two degrees of freedom such as pan and tilt.

The remote station computer **22** may operate Microsoft OS software and WINDOWS XP or other operating systems such as LINUX. The remote computer **22** may also operate a video driver, a camera driver, an audio driver and a joystick driver.

The video images may be transmitted and received with compression software such as MPEG CODEC.

The system **10** includes a patient monitor **50** that can display patient information. The patient monitor **50** is typically located within a patient's room at a healthcare facility. The patient monitor **50** can be any type of device that can display graphics, video images and text. By way of example, the patient monitor **50** may be a CRT monitor, flat screen, or a laptop computer.

The remote station **16** and patient monitor **50** may be coupled to a server **52** through the network **18**. The server **52** may contain electronic medical records of a patient. By way of example, the electronic medical records may include written records of treatment, patient history, medication information, a medical image, such as an x-ray, MRI or CT scan, EKGs, laboratory results, physician notes, etc. The medical records can be retrieved from the server **52** and displayed by the patient monitor **50**. The remote station **16** may allow the physician to modify the records and then store the modified records back in the server **52**. Although a server **52** is shown and described, it is to be understood that the information may be transferred directly from the remote station **16** to the patient monitor **50** without the server **52**. Although a medical application is described, it is to be understood that the system may be used in a non-medical application. For example, the monitor can be a computer monitor at an office or home, and the information can be business or personal in nature.

As shown in FIG. **2**, the system allows a physician to review medical information with a patient. The robot **12** displays an image of the physician so that the physician's presence is projected into a patient's room. The patient monitor **50** displays medical information that can be reviewed by the patient. The robot camera **38** allows the physician to see the patient and to view the medical information displayed by the patient monitor **50**. By way of example, the patient monitor **50** can display an x-ray of the patient and the physician can discuss the x-ray with the patient through the two-way video conferencing function of the system. The system may also allow the physician to highlight features of the x-ray with a tele-strating function.

FIGS. **3** and **4** show an embodiment of a robot **12**. Each robot **12** may include a high level control system **60** and a low level control system **62**. The high level control system **60** may include a processor **64** that is connected to a bus **66**. The bus is coupled to the camera **38** by an input/output (I/O) port **68**, and to the monitor **40** by a serial output port **70** and a VGA driver **72**. The monitor **40** may include a touchscreen function that allows the patient to enter input by touching the monitor screen.

The speaker **44** is coupled to the bus **66** by a digital to analog converter **74**. The microphone **42** is coupled to the bus **66** by an analog to digital converter **76**. The high level controller **60** may also contain random access memory (RAM) device **78**, a non-volatile RAM device **80** and a mass storage device **82** that are all coupled to the bus **72**. The mass storage device **82** may contain medical files of the patient that can be accessed by the user at the remote control station **16**. For example, the mass storage device **82** may contain a picture of the patient. The user, particularly a health care provider, can recall the old picture and make a side by side comparison on the monitor **24** with a present video image of the patient provided by the camera **38**. The robot antennae **46** may be coupled to a wireless transceiver **84**. By way of example, the transceiver **84** may transmit and receive information in accordance with IEEE 802.11b. The transceiver **84** may also process signals from the medical monitoring device in accordance with IEEE also known as Bluetooth. The robot may have a separate antennae to receive the wireless signals from the medical monitoring device.

The controller **64** may operate with a LINUX OS operating system. The controller **64** may also operate MS WINDOWS along with video, camera and audio drivers for communication with the remote control station **16**. Video information may be transceived using MPEG CODEC compression techniques. The software may allow the user to send e-mail to the patient and vice versa, or allow the patient to access the Internet. In general the high level controller **60** operates to control communication between the robot **12** and the remote control station **16**.

The high level controller **60** may be linked to the low level controller **62** by serial ports **86** and **88**. The low level controller **62** includes a processor **90** that is coupled to a RAM device **92** and non-volatile RAM device **94** by a bus **96**. Each robot **12** contains a plurality of motors **98** and motor encoders **100**. The motors **98** can activate the movement platform and move other parts of the robot such as the monitor and camera. The encoders **100** provide feedback information regarding the output of the motors **98**. The motors **98** can be coupled to the bus **96** by a digital to analog converter **102** and a driver amplifier **104**. The encoders **100** can be coupled to the bus **96** by a decoder **106**. Each robot **12** also has a number of proximity sensors **108** (see also FIG. **1**). The position sensors **108** can be coupled to the bus **96** by a signal conditioning circuit **110** and an analog to digital converter **112**.

The low level controller **62** runs software routines that mechanically actuate the robot **12**. For example, the low level controller **62** provides instructions to actuate the movement platform to move the robot **12**. The low level controller **62** may receive movement instructions from the high level controller **60**. The movement instructions may be received as movement commands from the remote control station or another robot. Although two controllers are shown, it is to be understood that each robot **12** may have one controller, or more than two controllers, controlling the high and low level functions.

The various electrical devices of each robot **12** may be powered by a battery(ies) **114**. The battery **114** may be recharged by a battery recharger station **116**. The low level controller **62** may include a battery control circuit **118** that senses the power level of the battery **114**. The low level controller **62** can sense when the power falls below a threshold and then send a message to the high level controller **60**.

The system may be the same or similar to a robotic system provided by the assignee InTouch-Health, Inc. of Santa Barbara, Calif. under the name RP-6 or RP-7, which is hereby incorporated by reference. The system may also be the same or similar to the system disclosed in application Ser. No. 10/206,457 published on Jan. 29, 2004, which is hereby incorporated by reference.

FIG. **5** shows a visual display **120** of the remote station. The visual display **120** displays a first screen field **122** and a second screen field **124**. The two screen fields may be created by two different monitors. Alternatively, the two screen fields may be displayed by one monitor. The first and second screen fields **122** and **124** may be part of an application program(s) stored and operated by the computer **22** of the remote station **16**.

FIG. **6** shows a first screen field **122**. The first screen field **122** may include a robot view field **126** that displays a video image captured by the camera of the robot. The first field **122** may also include a station view field **128** that displays a video image provided by the camera of the remote station. The first

field **122** may have a capture button **130** that can be selected to move at least a portion of the record field **124** into the robot view field **126**.

As shown in FIGS. **7** and **8**, the highlighted portion **132** of the second screen **124** may be copied to the robot view field **126**. By way of example, a graphical rectangle may be drawn around a portion of the second field through manipulation of a mouse. The ability to create the rectangle may be enabled by the selection of the capture button **130**. The highlighted portion of the second screen **132** may automatically populate the robot view field **126** when the rectangle is completed by the user.

As shown in FIG. **9**, the first screen field **122** may have a share button **134** that transfers the contents of the robot image field to the robot monitors. In this manner, the user can transfer the highlighted portion of the second screen field to the robot monitor. The transferred robot field contents are also displayed in the station view field **128**. The user can switch back to a live feed from the robot camera by selecting the live button **136**, as shown in FIG. **10**. Likewise, the robot monitor may display a live feed of the remote station operator by selecting the live button **138**, as shown in FIG. **11**.

Referring to FIG. **6**, the field **122** may have a button **144** that can be selected to transfer the contents of the second screen field **124** to the patient monitor **50**. The system may provide the ability to annotate the image displayed in field **126** and/or **128**. For example, a doctor at the remote station may annotate some portion of the image captured by the robot camera. The annotated image may be stored by the system. The system may also allow for annotation of images sent to the patient monitor **50** through the button **140**. For example, a doctor may send a medical image, such as an x-ray, MRI or CT scan to the patient monitor. The medical image is displayed by the patient monitor **50**. The doctor can annotate the medical image to point out a portion of the medical image to personnel located at the robot site. This allows the doctor to review the information with the patient as shown in FIG. **2**.

The second screen field may display a variety of different applications. For example, the second field **124** may display patient records, a medical image, etc. By way of example, the record field **124** may be a medical records program provided by Global Care Quest Corp. of Los Angeles, Calif.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A medical system for a patient, comprising:
- a patient monitor that displays patient information;
- a mobile robot that has a robot monitor, and a robot camera that captures an image, said robot camera being capable of viewing the patient and said patient monitor; and
- a remote station that is coupled to said mobile robot, said remote station includes a remote station monitor that displays the image captured by said robot camera and a remote station camera that captures an image that is displayed by said robot monitor.

2. The system of claim **1**, further comprising a server that is coupled to said remote station and said patient monitor and provides said patient information.

3. The system of claim **1**, wherein said patient information is displayed by said remote station monitor.

4. The system of claim **1**, further comprising a broadband network that is coupled to said remote station and said mobile robot.

5. The system of claim **1**, wherein said robot monitor and said robot camera move together in at least one degree of freedom.

6. The system of claim **1**, wherein said patient information includes a medical image.

7. A method for interacting with a patient, comprising:
- moving a mobile robot that has a camera to view a patient and a patient monitor;
- displaying patient information on the patient monitor; and, conducting a two-way video conference between the patient, and a medical personnel at a remote station that controls movement of the robot.

8. The method of claim **7**, wherein the patient information is provided by the remote station.

9. The method of claim **7**, wherein the patient information is provided by a server.

10. The method of claim **7**, wherein the patient information is displayed by a remote station monitor.

11. The method of claim **7**, further comprising transmitting robot control commands from the remote station to the mobile robot through a broadband network.

12. The method of claim **7**, further comprising moving together a robot camera and a robot monitor in at least one degree of freedom.

13. The method of claim **7**, wherein the patient information includes a medical image.

* * * * *

Exhibit B

US010471588B2

(12) **United States Patent**
Wright et al.

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(45) **Date of Patent: Nov. 12, 2019**

(54) **ROBOTIC BASED HEALTH CARE SYSTEM**

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(58) **Field of Classification Search**

USPC 700/259, 245; 901/47, 1; 348/14.01, 348/14.03, 14.08; 455/3.03, 419

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995 A	7/1974	Aghnides
4,107,689 A	8/1978	Jellinek
4,213,182 A	7/1980	Eichelberger et al.

(Continued)

FOREIGN PATENT DOCUMENTS

AU	1216200 A	5/2000
CA	2289697 A	11/1998

(Continued)

OTHER PUBLICATIONS

Android Amusement Corp., "What Marketing Secret . . . Renting Robots from Android Amusement Corp!", (Advertisement), 1982.

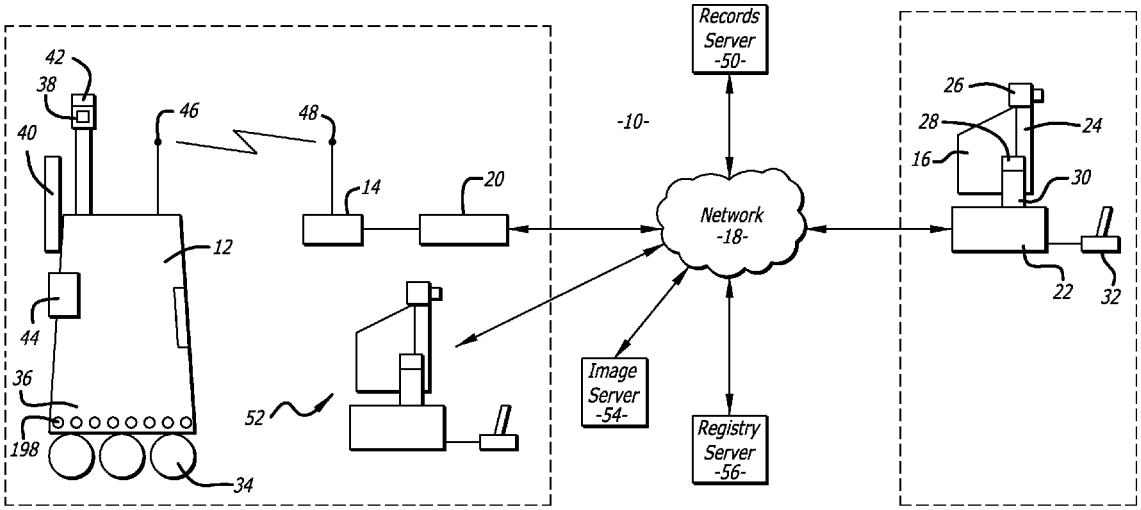
(Continued)

Primary Examiner — George C Monikang

(57) **ABSTRACT**

A robotic system that can be used to treat a patient. The robotic system includes a mobile robot that has a camera. The mobile robot is controlled by a remote station that has a monitor. A physician can use the remote station to move the mobile robot into view of a patient. An image of the patient is transmitted from the robot camera to the remote station monitor. A medical personnel at the robot site can enter patient information into the system through a user interface. The patient information can be stored in a server. The physician can access the information from the remote station. The remote station may provide graphical user interfaces that display the patient information and provide both a medical tool and a patient management plan.

7 Claims, 8 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,413,693	A	11/1983	Derby
4,471,354	A	9/1984	Smith
4,519,466	A	5/1985	Shiraishi
4,553,309	A	11/1985	Hess et al.
4,572,594	A	2/1986	Schwartz
4,625,274	A	11/1986	Schroeder
4,638,445	A	1/1987	Mattaboni
4,652,204	A	3/1987	Arnett
4,669,168	A	6/1987	Tamura et al.
4,679,152	A	7/1987	Perdue
4,697,278	A	9/1987	Fleischer
4,697,472	A	10/1987	Hiyane
4,709,265	A	11/1987	Silverman et al.
4,733,737	A	3/1988	Falamak
4,751,658	A	6/1988	Kadonoff et al.
4,766,581	A	8/1988	Korn et al.
4,777,416	A	10/1988	George et al.
4,797,557	A	1/1989	Ohman
4,803,625	A	2/1989	Fu et al.
4,847,764	A	7/1989	Halvorson
4,875,172	A	10/1989	Kanayama
4,878,501	A	11/1989	Shue
4,942,512	A	7/1990	Kohno
4,942,538	A	7/1990	Yuan et al.
4,953,159	A	8/1990	Hayden et al.
4,974,607	A	12/1990	Miwa
4,977,971	A	12/1990	Crane, III et al.
5,006,988	A	4/1991	Borenstein et al.
5,040,116	A	8/1991	Evans, Jr. et al.
5,051,906	A	9/1991	Evans et al.
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,130,794	A	7/1992	Ritchey
5,148,591	A	9/1992	Pryor
5,153,833	A	10/1992	Gordon et al.
5,155,684	A	10/1992	Burke et al.
5,157,491	A	10/1992	Kassatly
5,182,641	A	1/1993	Diner et al.
5,186,270	A	2/1993	West
5,193,143	A	3/1993	Kaemmerer et al.
5,217,453	A	6/1993	Wilk
5,220,263	A	6/1993	Onishi et al.
5,224,157	A	6/1993	Yamada et al.
5,230,023	A	7/1993	Nakano
5,231,693	A	7/1993	Backes et al.
5,236,432	A	8/1993	Matsen, III et al.
5,262,944	A	11/1993	Weisner et al.
5,305,427	A	4/1994	Nagata
5,315,287	A	5/1994	Sol
5,319,611	A	6/1994	Korba
5,341,242	A	8/1994	Gilboa et al.
5,341,459	A	8/1994	Backes
5,341,854	A	8/1994	Zezulka et al.
5,347,306	A	9/1994	Nitta
5,347,457	A	9/1994	Tanaka et al.
5,350,033	A	9/1994	Kraft
5,366,896	A	11/1994	Margrey
5,374,879	A	12/1994	Pin et al.
5,375,195	A	12/1994	Johnston
5,400,068	A	3/1995	Ishida et al.
5,413,693	A	5/1995	Redepenning
5,417,210	A	5/1995	Funda et al.
5,419,008	A	5/1995	West
5,436,542	A	7/1995	Petelin et al.
5,441,042	A	8/1995	Putman
5,441,047	A	8/1995	David et al.
5,442,728	A	8/1995	Kaufman et al.
5,462,051	A	10/1995	Oka et al.
5,486,853	A	1/1996	Baxter et al.
5,510,832	A	4/1996	Garcia
5,511,147	A	4/1996	Abdel-Malek
5,528,289	A	6/1996	Cortjens et al.
5,539,741	A	7/1996	Barraclough et al.
5,544,649	A	8/1996	David et al.
5,550,577	A	8/1996	Verbiest et al.
5,553,609	A	9/1996	Chen et al.
5,563,998	A	10/1996	Yaksich et al.
5,572,229	A	11/1996	Fisher
5,572,999	A	11/1996	Funda et al.
5,594,859	A	1/1997	Palmer et al.
5,600,573	A	2/1997	Hendricks et al.
5,617,539	A	4/1997	Ludwig et al.
5,619,341	A	4/1997	Auyeung et al.
5,623,679	A	4/1997	Rivette et al.
5,630,566	A	5/1997	Case
5,636,218	A	6/1997	Ishikawa et al.
5,652,849	A	7/1997	Conway et al.
5,657,246	A	8/1997	Hogan et al.
5,659,779	A	8/1997	Laird et al.
5,673,082	A	9/1997	Wells et al.
5,675,229	A	10/1997	Thorne
5,682,199	A	10/1997	Lankford
5,684,695	A	11/1997	Bauer
5,701,904	A	12/1997	Simmons et al.
5,734,805	A	3/1998	Isensee et al.
5,739,657	A	4/1998	Takayama et al.
5,748,629	A	5/1998	Caldara et al.
5,749,058	A	5/1998	Hashimoto
5,749,362	A	5/1998	Funda et al.
5,754,631	A	5/1998	Cave
5,758,079	A	5/1998	Ludwig et al.
5,762,458	A	6/1998	Wang et al.
5,764,731	A	6/1998	Yablon
5,767,897	A	6/1998	Howell
5,786,846	A	7/1998	Hiroaki
5,787,545	A	8/1998	Colens
5,793,365	A	8/1998	Tang et al.
5,801,755	A	9/1998	Echerer
5,802,494	A	9/1998	Kuno
5,836,872	A	11/1998	Kenet et al.
5,838,575	A	11/1998	Lion
5,844,599	A	12/1998	Hildin
5,857,534	A	1/1999	DeVault et al.
5,867,494	A	2/1999	Krishnaswamy et al.
5,867,653	A	2/1999	Aras et al.
5,871,451	A	2/1999	Unger et al.
5,872,922	A	2/1999	Hogan et al.
5,876,325	A	3/1999	Mizuno et al.
5,911,036	A	6/1999	Wright et al.
5,917,958	A	6/1999	Nunally et al.
5,927,423	A	7/1999	Wada et al.
5,949,758	A	9/1999	Kober et al.
5,954,692	A	9/1999	Smith et al.
5,959,423	A	9/1999	Nakanishi et al.
5,961,446	A	10/1999	Beller et al.
5,966,130	A	10/1999	Benman, Jr.
5,973,724	A	10/1999	Riddle
5,974,446	A	10/1999	Sonnenreich et al.
5,983,263	A	11/1999	Rothrock et al.
5,995,119	A	11/1999	Cosatto et al.
5,995,884	A	11/1999	Allen et al.
5,999,977	A	12/1999	Riddle
6,006,946	A	12/1999	Williams et al.
6,031,845	A	2/2000	Walding
6,036,812	A	3/2000	Williams et al.
6,047,259	A	4/2000	Campbell et al.
6,091,219	A	7/2000	Maruo et al.
6,113,343	A	9/2000	Goldenberg et al.
6,133,944	A	10/2000	Braun et al.
6,135,228	A	10/2000	Asada et al.
6,148,100	A	11/2000	Anderson et al.
6,160,582	A	12/2000	Hill
6,170,929	B1	1/2001	Wilson et al.
6,175,779	B1	1/2001	Barrett
6,189,034	B1	2/2001	Riddle
6,201,984	B1	3/2001	Funda et al.
6,211,903	B1	4/2001	Bullister
6,219,587	B1	4/2001	Ahlin et al.
6,232,735	B1	5/2001	Baba et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,233,504 B1 5/2001 Das et al.
6,233,735 B1 5/2001 Ebihara
6,250,928 B1 6/2001 Poggio et al.
6,256,556 B1 7/2001 Zenke
6,259,806 B1 7/2001 Green
6,259,956 B1 7/2001 Myers et al.
6,266,162 B1 7/2001 Okamura et al.
6,266,577 B1 7/2001 Popp et al.
6,289,263 B1 9/2001 Mukherjee
6,292,713 B1 9/2001 Jouppi et al.
6,292,714 B1 9/2001 Okabayashi
6,304,050 B1 10/2001 Skaar et al.
6,314,631 B1 11/2001 Pryor
6,317,652 B1 11/2001 Osada
6,317,953 B1 11/2001 Pryor
6,321,137 B1 11/2001 De Smet
6,324,184 B1 11/2001 Hou et al.
6,324,443 B1 11/2001 Kurakake et al.
6,325,756 B1 12/2001 Webb et al.
6,327,516 B1 12/2001 Zenke
6,330,486 B1 12/2001 Padula
6,330,493 B1 12/2001 Takahashi et al.
6,346,950 B1 2/2002 Jouppi
6,346,962 B1 2/2002 Goodridge
6,369,847 B1 4/2002 James et al.
6,373,855 B1 4/2002 Downing et al.
6,381,515 B1 4/2002 Inoue et al.
6,389,329 B1 5/2002 Colens
6,400,378 B1 6/2002 Snook
6,408,230 B2 6/2002 Wada
6,411,055 B1 6/2002 Fujita et al.
6,430,471 B1 8/2002 Kintou et al.
6,430,475 B2 8/2002 Okamoto et al.
6,438,457 B1 8/2002 Yokoo et al.
6,445,964 B1 9/2002 White et al.
6,449,762 B1 9/2002 McElvain
6,452,915 B1 9/2002 Jorgensen
6,457,043 B1 9/2002 Kwak et al.
6,459,955 B1 10/2002 Bartsch et al.
6,463,352 B1 10/2002 Tadokoro et al.
6,463,361 B1 10/2002 Wang et al.
6,466,844 B1 10/2002 Ikeda et al.
6,468,265 B1 10/2002 Evans et al.
6,470,235 B2 10/2002 Kasuga et al.
6,474,434 B1 11/2002 Bech
6,480,762 B1 11/2002 Uchikubo et al.
6,491,701 B2 12/2002 Tierney et al.
6,496,099 B2 12/2002 Wang et al.
6,496,755 B2 12/2002 Wallach et al.
6,501,740 B1 12/2002 Sun et al.
6,507,773 B2 1/2003 Parker et al.
6,522,906 B1 2/2003 Salisbury, Jr. et al.
6,523,629 B1 2/2003 Buttz et al.
6,526,332 B2 2/2003 Sakamoto et al.
6,529,620 B2 3/2003 Thompson
6,529,765 B1 3/2003 Franck
6,529,802 B1 3/2003 Kawakita et al.
6,532,404 B2 3/2003 Colens
6,535,182 B2 3/2003 Stanton
6,535,793 B2 3/2003 Allard
6,540,039 B1 4/2003 Yu et al.
6,543,899 B2 4/2003 Covannon et al.
6,549,215 B2 4/2003 Jouppi
6,563,533 B1 5/2003 Colby
6,567,038 B1 5/2003 Granot et al.
6,580,246 B2 6/2003 Jacobs
6,581,798 B2 6/2003 Liff et al.
6,584,376 B1 6/2003 Van Kommer
6,587,750 B2 7/2003 Gerbi et al.
6,590,604 B1 7/2003 Tucker et al.
6,594,269 B1 7/2003 Polcyn
6,594,552 B1 7/2003 Nowlin et al.
6,597,392 B1 7/2003 Jenkins et al.
6,602,469 B1 8/2003 Maus et al.
6,604,019 B2 8/2003 Ahlin et al.
6,604,021 B2 8/2003 Imai et al.
6,611,120 B2 8/2003 Song et al.
6,643,496 B1 11/2003 Shimoyama et al.
6,646,677 B2 11/2003 Noro et al.
6,650,748 B1 11/2003 Edwards et al.
6,666,374 B1 12/2003 Green et al.
6,667,592 B2 12/2003 Jacobs et al.
6,674,259 B1 1/2004 Norman et al.
6,684,129 B2 1/2004 Salisbury, Jr. et al.
6,691,000 B2 2/2004 Nagai et al.
6,693,585 B1 2/2004 MacLeod
6,710,797 B1 3/2004 McNelley et al.
6,724,823 B2 4/2004 Rovati et al.
6,728,599 B2 4/2004 Wang et al.
6,763,282 B2 7/2004 Glenn et al.
6,764,373 B1 7/2004 Osawa et al.
6,769,771 B2 8/2004 Trumbull
6,781,606 B2 8/2004 Jouppi
6,784,916 B2 8/2004 Smith
6,785,589 B2 8/2004 Eggenberger et al.
6,791,550 B2 9/2004 Goldhor et al.
6,798,753 B1 9/2004 Doganata et al.
6,799,065 B1 9/2004 Niemeyer
6,799,088 B2 9/2004 Wang et al.
6,804,580 B1 10/2004 Stoddard et al.
6,804,656 B1 10/2004 Rosenfeld et al.
6,810,411 B1 10/2004 Coughlin et al.
6,816,192 B1 11/2004 Nishikawa
6,816,754 B2 11/2004 Mukai et al.
6,836,703 B2 12/2004 Wang et al.
6,839,612 B2 1/2005 Sanchez et al.
6,840,904 B2 1/2005 Goldberg
6,845,297 B2 1/2005 Allard
6,852,107 B2 2/2005 Wang et al.
6,853,878 B2 2/2005 Hirayama et al.
6,853,880 B2 2/2005 Sakagami et al.
6,871,117 B2 3/2005 Wang et al.
6,879,879 B2 4/2005 Jouppi et al.
6,888,333 B2 5/2005 Laby
6,892,112 B2 5/2005 Wang et al.
6,893,267 B1 5/2005 Yueh
6,895,305 B2 5/2005 Lathan et al.
6,898,484 B2 5/2005 Lemelson et al.
6,914,622 B1 7/2005 Smith et al.
6,925,357 B2 8/2005 Wang et al.
6,951,535 B2 10/2005 Ghodoussi et al.
6,952,470 B1 10/2005 Tioe et al.
6,957,712 B2 10/2005 Song et al.
6,958,706 B2 10/2005 Chaco et al.
6,965,394 B2 11/2005 Gutta et al.
6,990,112 B1 1/2006 Brent et al.
6,995,664 B1 2/2006 Darling
7,007,235 B1 2/2006 Hussein et al.
7,011,538 B2 3/2006 Chang
7,015,934 B2 3/2006 Toyama et al.
RE39,080 E 4/2006 Johnston
7,030,757 B2 4/2006 Matsuhira et al.
7,053,578 B2 5/2006 Diehl et al.
7,055,210 B2 6/2006 Keppler et al.
7,058,689 B2 6/2006 Parker et al.
7,092,001 B2 8/2006 Schulz
7,096,090 B1 8/2006 Zweig
7,115,102 B2 10/2006 Abbruscato
7,117,067 B2 10/2006 McLurkin et al.
7,123,285 B2 10/2006 Smith et al.
7,123,974 B1 10/2006 Hamilton
7,123,991 B2 10/2006 Graf et al.
7,127,325 B2 10/2006 Nagata et al.
7,129,970 B2 10/2006 James et al.
7,133,062 B2 11/2006 Castles et al.
7,142,945 B2 11/2006 Wang et al.
7,142,947 B2 11/2006 Wang et al.
7,151,982 B2 12/2006 Liff et al.
7,154,526 B2 12/2006 Foote et al.
7,155,306 B2 12/2006 Haitin et al.
7,156,809 B2 1/2007 Quy
7,158,859 B2 1/2007 Wang et al.
7,158,860 B2 1/2007 Wang et al.
7,158,861 B2 1/2007 Wang et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,161,322 B2 1/2007 Wang et al.
7,162,338 B2 1/2007 Goncalves et al.
7,164,969 B2 1/2007 Wang et al.
7,164,970 B2 1/2007 Wang et al.
7,167,448 B2 1/2007 Wookey et al.
7,171,286 B2 1/2007 Wang et al.
7,174,238 B1 2/2007 Zweig
7,181,455 B2 2/2007 Wookey et al.
7,184,559 B2 2/2007 Jouppi
7,188,000 B2 3/2007 Chiappetta et al.
7,199,790 B2 4/2007 Rosenberg et al.
7,202,851 B2 4/2007 Cunningham et al.
7,206,627 B2 4/2007 Abovitz et al.
7,215,786 B2 5/2007 Nakadai et al.
7,219,364 B2 5/2007 Bolle et al.
7,222,000 B2 5/2007 Wang et al.
7,227,334 B2 6/2007 Yang et al.
7,256,708 B2 8/2007 Rosenfeld et al.
7,262,573 B2 8/2007 Wang et al.
7,283,153 B2 10/2007 Provost et al.
7,289,883 B2 10/2007 Wang et al.
7,292,257 B2 11/2007 Kang et al.
7,292,912 B2 11/2007 Way et al.
7,305,114 B2 12/2007 Wolff et al.
7,317,685 B1 1/2008 Flott et al.
7,321,807 B2 1/2008 Laski
7,332,890 B2 2/2008 Cohen et al.
7,333,642 B2 2/2008 Green
7,346,429 B2 3/2008 Goldenberg et al.
7,352,153 B2 4/2008 Yan
7,363,121 B1 4/2008 Chen et al.
7,382,399 B1 6/2008 McCall et al.
7,386,730 B2 6/2008 Uchikubo
7,391,432 B2 6/2008 Terada
7,400,578 B2 7/2008 Guthrie et al.
7,404,140 B2 7/2008 O'Rourke
7,421,470 B2 9/2008 Ludwig et al.
7,430,209 B2 9/2008 Porter
7,432,949 B2 10/2008 Remy et al.
7,433,921 B2 10/2008 Ludwig et al.
7,441,953 B2 10/2008 Banks
7,467,211 B1 12/2008 Herman et al.
7,483,867 B2 1/2009 Ansari et al.
7,492,731 B2 2/2009 Hagendorf
7,510,428 B2 3/2009 Obata et al.
7,523,069 B1 4/2009 Friedl et al.
7,525,281 B2 4/2009 Koyanagi et al.
7,535,486 B2 5/2009 Motomura et al.
7,557,758 B2 7/2009 Rofougaran
7,587,260 B2 9/2009 Bruemmer et al.
7,587,512 B2 9/2009 Ta et al.
7,590,060 B2 9/2009 Miceli
7,593,030 B2 9/2009 Way et al.
7,599,290 B2 10/2009 Dos Remedios et al.
7,624,166 B2 11/2009 Foote et al.
7,630,314 B2 12/2009 Dos Remedios et al.
7,631,833 B1 12/2009 Ghaleb et al.
7,643,051 B2 1/2010 Sandberg et al.
7,647,320 B2 1/2010 Mok et al.
7,657,560 B1 2/2010 Dirienzo
7,680,038 B1 3/2010 Gourlay
7,693,757 B2 4/2010 Zimmerman
7,698,432 B2 4/2010 Short et al.
7,702,524 B1 * 4/2010 Whibbs G06Q 50/22 705/2
7,703,113 B2 4/2010 Dawson
7,719,229 B2 5/2010 Kaneko et al.
7,737,993 B2 6/2010 Kaasila et al.
7,739,383 B1 6/2010 Short et al.
7,756,614 B2 7/2010 Jouppi
7,761,185 B2 7/2010 Wang et al.
7,769,492 B2 8/2010 Wang et al.
7,769,705 B1 8/2010 Luechtefeld
7,774,158 B2 8/2010 Domingues Goncalves et al.
7,813,836 B2 10/2010 Wang et al.
7,831,575 B2 11/2010 Trossell et al.
7,835,775 B2 11/2010 Sawayama et al.
7,860,680 B2 12/2010 Arms et al.
7,861,366 B2 1/2011 Hahm et al.
7,885,822 B2 2/2011 Akers et al.
7,890,382 B2 2/2011 Robb et al.
7,912,583 B2 3/2011 Gutmann et al.
RE42,288 E 4/2011 Degioanni
7,924,323 B2 4/2011 Walker et al.
7,949,616 B2 5/2011 Levy et al.
7,956,894 B2 6/2011 Akers et al.
7,957,837 B2 6/2011 Ziegler et al.
7,982,763 B2 7/2011 King
7,982,769 B2 7/2011 Jenkins et al.
7,987,069 B2 7/2011 Rodgers et al.
8,077,963 B2 12/2011 Wang et al.
8,116,910 B2 2/2012 Walters et al.
8,126,960 B2 2/2012 Obradovich et al.
8,170,241 B2 5/2012 Roe et al.
8,179,418 B2 5/2012 Wright et al.
8,180,486 B2 5/2012 Saito et al.
8,209,051 B2 6/2012 Yulun et al.
8,212,533 B2 7/2012 Ota
8,265,793 B2 9/2012 Cross et al.
8,287,522 B2 10/2012 Moses et al.
8,292,807 B2 10/2012 Perkins et al.
8,320,534 B2 11/2012 Kim et al.
8,340,654 B2 12/2012 Bratton et al.
8,340,819 B2 12/2012 Mangaser et al.
8,348,675 B2 1/2013 Dohrmann
8,374,171 B2 2/2013 Cho et al.
8,400,491 B1 3/2013 Panpaliya et al.
8,401,275 B2 3/2013 Wang et al.
8,423,284 B2 4/2013 O'Shea
8,451,731 B1 5/2013 Lee et al.
8,463,435 B2 6/2013 Herzog et al.
8,503,340 B1 8/2013 Xu
8,515,577 B2 8/2013 Wang et al.
8,527,094 B2 9/2013 Kumar et al.
8,532,860 B2 9/2013 Daly
8,610,786 B2 12/2013 Ortiz
8,612,051 B2 12/2013 Norman et al.
8,639,797 B1 1/2014 Pan et al.
8,670,017 B2 3/2014 Stuart et al.
8,726,454 B2 5/2014 Gilbert et al.
8,836,751 B2 9/2014 Ballantyne et al.
8,849,679 B2 9/2014 Wang et al.
8,849,680 B2 9/2014 Wright et al.
8,861,750 B2 10/2014 Roe et al.
8,897,920 B2 11/2014 Wang et al.
8,902,278 B2 12/2014 Pinter et al.
2001/0002448 A1 5/2001 Wilson
2001/0010053 A1 7/2001 Ben-Shachar et al.
2001/0020200 A1 9/2001 Das et al.
2001/0034475 A1 10/2001 Flach et al.
2001/0034544 A1 10/2001 Mo
2001/0037163 A1 11/2001 Allard
2001/0048464 A1 12/2001 Barnett
2001/0051881 A1 12/2001 Filler
2001/0054071 A1 12/2001 Loeb
2001/0055373 A1 12/2001 Yamashita
2002/0015296 A1 2/2002 Howell et al.
2002/0027597 A1 3/2002 Sachau
2002/0027652 A1 3/2002 Paromtchik et al.
2002/0033880 A1 3/2002 Sul et al.
2002/0038168 A1 3/2002 Kasuga et al.
2002/0044201 A1 4/2002 Alexander et al.
2002/0049517 A1 4/2002 Ruffner
2002/0055917 A1 5/2002 Muraca
2002/0057279 A1 * 5/2002 Jouppi 345/619
2002/0058929 A1 5/2002 Green
2002/0059587 A1 5/2002 Cofano et al.
2002/0063726 A1 5/2002 Jouppi
2002/0073429 A1 6/2002 Beane et al.
2002/0082498 A1 6/2002 Wendt et al.
2002/0085030 A1 7/2002 Ghani
2002/0095238 A1 * 7/2002 Ahlin et al. 700/243
2002/0095239 A1 7/2002 Wallach et al.
2002/0098879 A1 7/2002 Rheey

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0104094 A1 8/2002 Alexander et al.
2002/0106998 A1 8/2002 Presley et al.
2002/0109770 A1 8/2002 Terada
2002/0109775 A1 8/2002 White et al.
2002/0111988 A1 8/2002 Sato
2002/0120362 A1 8/2002 Lathan et al.
2002/0128985 A1 9/2002 Greenwald
2002/0130950 A1 9/2002 James et al.
2002/0133062 A1 9/2002 Arling et al.
2002/0141595 A1 10/2002 Alexander
2002/0143923 A1 10/2002 Alexander
2002/0177925 A1 11/2002 Onishi et al.
2002/0183894 A1 12/2002 Wang et al.
2002/0184674 A1 12/2002 Xi et al.
2002/0186243 A1 12/2002 Ellis et al.
2003/0021107 A1 1/2003 Howell et al.
2003/0030397 A1 2/2003 Simmons
2003/0048481 A1 3/2003 Kobayashi et al.
2003/0050733 A1 3/2003 Wang et al.
2003/0050734 A1 3/2003 Lapham
2003/0060808 A1 3/2003 Wilk
2003/0063600 A1 4/2003 Noma et al.
2003/0069752 A1 4/2003 Ledain et al.
2003/0080901 A1 5/2003 Piotrowski
2003/0100892 A1 5/2003 Morley et al.
2003/0104806 A1 6/2003 Ruef et al.
2003/0112823 A1 6/2003 Collins et al.
2003/0114962 A1 6/2003 Niemeyer et al.
2003/0120714 A1 6/2003 Wolff et al.
2003/0126361 A1 7/2003 Slater et al.
2003/0135097 A1 7/2003 Wiederhold et al.
2003/0135203 A1 7/2003 Wang et al.
2003/0144579 A1 7/2003 Buss
2003/0144649 A1 7/2003 Ghodoussi et al.
2003/0151658 A1 8/2003 Smith
2003/0152145 A1 8/2003 Kawakita
2003/0171710 A1 9/2003 Bassuk et al.
2003/0174285 A1 9/2003 Trumbull
2003/0180697 A1 9/2003 Kim et al.
2003/0195662 A1 10/2003 Wang et al.
2003/0199000 A1 10/2003 Valkirs et al.
2003/0206242 A1 11/2003 Choi et al.
2003/0212472 A1 11/2003 McKee
2003/0216833 A1 11/2003 Mukai et al.
2003/0216834 A1 11/2003 Allard
2003/0220541 A1 11/2003 Salisbury, Jr. et al.
2003/0220715 A1 11/2003 William et al.
2003/0231244 A1 12/2003 Bonilla et al.
2003/0232649 A1 12/2003 Gizis
2003/0236590 A1 12/2003 Park et al.
2004/0001197 A1 1/2004 Ko et al.
2004/0001676 A1 1/2004 Colgan et al.
2004/0008138 A1 1/2004 Hockley, Jr. et al.
2004/0010344 A1 1/2004 Hiratsuka
2004/0012362 A1 1/2004 Tsurumi
2004/0013295 A1 1/2004 Sabe et al.
2004/0017475 A1 1/2004 Akers et al.
2004/0019406 A1 1/2004 Wang et al.
2004/0024490 A1 2/2004 McLurkin et al.
2004/0041904 A1 3/2004 Lapalme et al.
2004/0065073 A1 4/2004 Nash
2004/0068657 A1 4/2004 Alexander et al.
2004/0078219 A1 4/2004 Kaylor et al.
2004/0080610 A1 4/2004 James et al.
2004/0088077 A1 5/2004 Jouppi et al.
2004/0088078 A1 5/2004 Jouppi et al.
2004/0093409 A1 5/2004 Thompson et al.
2004/0095516 A1 5/2004 Rohlicek
2004/0098167 A1 5/2004 Yi et al.
2004/0102167 A1 5/2004 Shim et al.
2004/0107254 A1 6/2004 Ludwig et al.
2004/0107255 A1 6/2004 Ludwig et al.
2004/0117065 A1 6/2004 Wang et al.
2004/0117067 A1 6/2004 Jouppi
2004/0123158 A1 6/2004 Roskind
2004/0135879 A1 7/2004 Stacy et al.
2004/0138547 A1 7/2004 Wang et al.
2004/0143421 A1 7/2004 Wang et al.
2004/0148638 A1 7/2004 Weisman et al.
2004/0150725 A1 8/2004 Taguchi
2004/0153211 A1 8/2004 Kamoto et al.
2004/0157612 A1 8/2004 Kim
2004/0162637 A1 8/2004 Wang et al.
2004/0167666 A1 8/2004 Wang et al.
2004/0167668 A1 8/2004 Wang et al.
2004/0168148 A1 8/2004 Goncalves et al.
2004/0170300 A1 9/2004 Jouppi
2004/0172301 A1 9/2004 Mihai et al.
2004/0172306 A1 9/2004 Wohl et al.
2004/0174129 A1 9/2004 Wang et al.
2004/0175684 A1 9/2004 Kaasa et al.
2004/0179714 A1 9/2004 Jouppi
2004/0186623 A1 9/2004 Dooley et al.
2004/0189700 A1 9/2004 Mandavilli et al.
2004/0201602 A1 10/2004 Mody et al.
2004/0205664 A1 10/2004 Prendergast
2004/0215490 A1 10/2004 Duchon et al.
2004/0218099 A1 11/2004 Washington
2004/0222638 A1 11/2004 Bednyak
2004/0224676 A1 11/2004 Iseki
2004/0230340 A1 11/2004 Fukuchi et al.
2004/0240981 A1 12/2004 Dothan et al.
2004/0241981 A1 12/2004 Dothan et al.
2004/0260790 A1 12/2004 Balloni et al.
2005/0003330 A1 1/2005 Asgarinejad et al.
2005/0004708 A1 1/2005 Goldenberg et al.
2005/0007445 A1 1/2005 Foote et al.
2005/0013149 A1 1/2005 Trossell
2005/0021182 A1 1/2005 Wang et al.
2005/0021183 A1 1/2005 Wang et al.
2005/0021187 A1 1/2005 Wang et al.
2005/0021309 A1 1/2005 Alexander et al.
2005/0024485 A1 2/2005 Castles et al.
2005/0027567 A1 2/2005 Taha
2005/0027794 A1 2/2005 Decker
2005/0028221 A1 2/2005 Liu et al.
2005/0035862 A1 2/2005 Wildman et al.
2005/0038416 A1 2/2005 Wang et al.
2005/0038564 A1 2/2005 Burick et al.
2005/0049898 A1 3/2005 Hirakawa
2005/0052527 A1 3/2005 Remy et al.
2005/0060211 A1 3/2005 Xiao et al.
2005/0065435 A1 3/2005 Rauch et al.
2005/0065438 A1 3/2005 Miller
2005/0065659 A1 3/2005 Tanaka et al.
2005/0065813 A1 3/2005 Mishelevich et al.
2005/0071046 A1 3/2005 Miyazaki et al.
2005/0073575 A1 4/2005 Thacher et al.
2005/0078816 A1 4/2005 Sekiguchi et al.
2005/0083011 A1 4/2005 Yang et al.
2005/0099493 A1 5/2005 Chew
2005/0104964 A1 5/2005 Bovyrin et al.
2005/0110867 A1 5/2005 Schulz
2005/0122390 A1 6/2005 Wang et al.
2005/0125083 A1 6/2005 Kiko
2005/0125098 A1 6/2005 Wang et al.
2005/0149364 A1 7/2005 Ombrellaro
2005/0152447 A1 7/2005 Jouppi et al.
2005/0152565 A1 7/2005 Jouppi et al.
2005/0154265 A1 7/2005 Miro et al.
2005/0168568 A1 8/2005 Jouppi
2005/0182322 A1 8/2005 Grispo
2005/0192721 A1 9/2005 Jouppi
2005/0204438 A1* 9/2005 Wang et al. 901/1
2005/0212478 A1 9/2005 Takenaka
2005/0219356 A1 10/2005 Smith et al.
2005/0225634 A1 10/2005 Brunetti et al.
2005/0231156 A1 10/2005 Yan
2005/0231586 A1 10/2005 Rodman et al.
2005/0232647 A1 10/2005 Takenaka
2005/0234592 A1 10/2005 McGee et al.
2005/0264649 A1 12/2005 Chang et al.
2005/0267826 A1 12/2005 Levy et al.
2005/0283414 A1 12/2005 Fernandes et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0286759 A1 12/2005 Zitnick et al.
2006/0007943 A1 1/2006 Fellman
2006/0010028 A1 1/2006 Sorensen
2006/0013263 A1 1/2006 Fellman
2006/0013469 A1 1/2006 Wang et al.
2006/0013488 A1 1/2006 Inoue
2006/0014388 A1 1/2006 Lur et al.
2006/0020694 A1 1/2006 Nag et al.
2006/0029065 A1 2/2006 Fellman
2006/0047365 A1 3/2006 Ghodoussi et al.
2006/0048286 A1 3/2006 Donato
2006/0052676 A1 3/2006 Wang et al.
2006/0052684 A1 3/2006 Takahashi et al.
2006/0056655 A1 3/2006 Wen et al.
2006/0056837 A1 3/2006 Vapaakoski
2006/0064212 A1 3/2006 Thorne
2006/0066609 A1 3/2006 Iodice et al.
2006/0071797 A1 4/2006 Rosenfeld et al.
2006/0074525 A1 4/2006 Close et al.
2006/0074719 A1 4/2006 Horner
2006/0082642 A1 4/2006 Wang et al.
2006/0087746 A1 4/2006 Lipow
2006/0095158 A1 5/2006 Lee et al.
2006/0095170 A1 5/2006 Yang et al.
2006/0098573 A1 5/2006 Beer et al.
2006/0103659 A1 5/2006 Karandikar et al.
2006/0104279 A1 5/2006 Fellman et al.
2006/0106493 A1 5/2006 Niemeyer et al.
2006/0122482 A1 6/2006 Mariotti et al.
2006/0125356 A1 6/2006 Meek, Jr. et al.
2006/0142983 A1 6/2006 Sorensen et al.
2006/0149418 A1 7/2006 Anvari
2006/0161136 A1 7/2006 Anderson et al.
2006/0161303 A1 7/2006 Wang et al.
2006/0164546 A1 7/2006 Adachi et al.
2006/0171515 A1 8/2006 Hintermeister et al.
2006/0173708 A1 8/2006 Vining et al.
2006/0173712 A1 8/2006 Joubert
2006/0178559 A1 8/2006 Kumar et al.
2006/0178776 A1 8/2006 Feingold et al.
2006/0178777 A1 8/2006 Park et al.
2006/0189393 A1 8/2006 Edery
2006/0195569 A1 8/2006 Barker
2006/0224781 A1 10/2006 Tsao et al.
2006/0247045 A1 11/2006 Jeong et al.
2006/0259193 A1 11/2006 Wang et al.
2006/0268704 A1 11/2006 Ansari et al.
2006/0271238 A1 11/2006 Choi et al.
2006/0271400 A1 11/2006 Clements et al.
2006/0293788 A1 12/2006 Pogodin
2007/0021871 A1 1/2007 Wang et al.
2007/0025711 A1 2/2007 Marcus
2007/0046237 A1 3/2007 Lakshmanan et al.
2007/0050937 A1 3/2007 Song et al.
2007/0064092 A1* 3/2007 Sandbeg et al. 348/14.02
2007/0078566 A1 4/2007 Wang et al.
2007/0093279 A1 4/2007 Janik
2007/0112700 A1 5/2007 Den et al.
2007/0116152 A1 5/2007 Thesling
2007/0117516 A1 5/2007 Saidi et al.
2007/0120965 A1 5/2007 Sandberg et al.
2007/0122783 A1 5/2007 Habashi
2007/0133407 A1 6/2007 Choi et al.
2007/0135967 A1 6/2007 Jung et al.
2007/0142964 A1 6/2007 Abramson
2007/0170886 A1 7/2007 Plishner
2007/0176060 A1 8/2007 White et al.
2007/0192910 A1 8/2007 Vu et al.
2007/0197896 A1 8/2007 Moll et al.
2007/0198128 A1 8/2007 Ziegler et al.
2007/0198130 A1 8/2007 Wang et al.
2007/0199108 A1 8/2007 Angle et al.
2007/0216347 A1 9/2007 Kaneko et al.
2007/0226949 A1 10/2007 Hahm et al.
2007/0250212 A1 10/2007 Halloran et al.
2007/0255706 A1 11/2007 Iketani et al.
2007/0262884 A1 11/2007 Goncalves et al.
2007/0273751 A1 11/2007 Sachau
2007/0290040 A1 12/2007 Wurman et al.
2007/0291109 A1 12/2007 Wang et al.
2007/0291128 A1 12/2007 Wang et al.
2008/0001774 A1* 1/2008 Huang G08C 17/00 340/13.24
2008/0009969 A1 1/2008 Bruemmer et al.
2008/0011904 A1 1/2008 Cepollina et al.
2008/0027591 A1 1/2008 Lenser et al.
2008/0033641 A1 2/2008 Medalia
2008/0045804 A1 2/2008 Williams
2008/0051985 A1 2/2008 D'Andrea et al.
2008/0065268 A1 3/2008 Wang et al.
2008/0082211 A1 4/2008 Wang et al.
2008/0086241 A1 4/2008 Phillips et al.
2008/0091340 A1 4/2008 Milstein et al.
2008/0126132 A1 5/2008 Warner et al.
2008/0133052 A1 6/2008 Jones et al.
2008/0161969 A1 7/2008 Lee et al.
2008/0174570 A1 7/2008 Jobs et al.
2008/0201016 A1 8/2008 Finlay
2008/0201017 A1 8/2008 Wang et al.
2008/0215987 A1 9/2008 Alexander et al.
2008/0229531 A1 9/2008 Takida
2008/0232763 A1 9/2008 Brady
2008/0255703 A1 10/2008 Wang et al.
2008/0263451 A1 10/2008 Portele et al.
2008/0263628 A1 10/2008 Norman et al.
2008/0267069 A1 10/2008 Thielman et al.
2008/0269949 A1 10/2008 Norman et al.
2008/0281467 A1 11/2008 Pinter
2008/0306375 A1 12/2008 Sayler et al.
2009/0023389 A1* 1/2009 Paryani H04N 21/42226 455/41.2
2009/0030552 A1 1/2009 Nakadai et al.
2009/0044334 A1 2/2009 Parsell et al.
2009/0049640 A1 2/2009 Lee et al.
2009/0055023 A1 2/2009 Walters et al.
2009/0070135 A1 3/2009 Parida et al.
2009/0086013 A1 4/2009 Thapa
2009/0102919 A1 4/2009 Zamierowski et al.
2009/0105882 A1 4/2009 Wang et al.
2009/0106679 A1 4/2009 Anzures et al.
2009/0122699 A1 5/2009 Alperovitch et al.
2009/0125147 A1 5/2009 Wang et al.
2009/0144425 A1 6/2009 Marr et al.
2009/0164255 A1 6/2009 Menschik et al.
2009/0164657 A1 6/2009 Li et al.
2009/0171170 A1* 7/2009 Li et al. 600/301
2009/0177323 A1 7/2009 Ziegler et al.
2009/0177641 A1 7/2009 Raghavan
2009/0237317 A1 9/2009 Rofougaran
2009/0240371 A1 9/2009 Wang et al.
2009/0248200 A1 10/2009 Root
2009/0259339 A1 10/2009 Wright et al.
2010/0010672 A1 1/2010 Wang et al.
2010/0010673 A1 1/2010 Wang et al.
2010/0017046 A1 1/2010 Cheung et al.
2010/0019715 A1 1/2010 Roe et al.
2010/0026239 A1 2/2010 Li et al.
2010/0030578 A1 2/2010 Siddique et al.
2010/0051596 A1 3/2010 Diedrick et al.
2010/0063848 A1 3/2010 Kremer et al.
2010/0066804 A1 3/2010 Shoemake et al.
2010/0070079 A1 3/2010 Mangaser et al.
2010/0073490 A1 3/2010 Wang et al.
2010/0076600 A1 3/2010 Cross et al.
2010/0085874 A1 4/2010 Noy et al.
2010/0088232 A1 4/2010 Gale
2010/0115418 A1 5/2010 Wang et al.
2010/0116566 A1 5/2010 Ohm et al.
2010/0131103 A1 5/2010 Herzog et al.
2010/0145479 A1 6/2010 Griffiths
2010/0157825 A1 6/2010 Anderlind et al.
2010/0171826 A1 7/2010 Hamilton et al.
2010/0191375 A1 7/2010 Wright et al.
2010/0228249 A1 9/2010 Mohr et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0268383	A1	10/2010	Wang et al.
2010/0278086	A1	11/2010	Pochiraju et al.
2010/0286905	A1	11/2010	Goncalves et al.
2010/0301679	A1	12/2010	Murray et al.
2010/0323783	A1	12/2010	Nonaka et al.
2011/0022705	A1	1/2011	Yellamraju et al.
2011/0050841	A1	3/2011	Wang et al.
2011/0071675	A1	3/2011	Wells et al.
2011/0071702	A1	3/2011	Wang et al.
2011/0072114	A1	3/2011	Hoffert et al.
2011/0153198	A1	6/2011	Kokkas et al.
2011/0172822	A1	7/2011	Ziegler et al.
2011/0187875	A1	8/2011	Sanchez et al.
2011/0190930	A1	8/2011	Hanrahan et al.
2011/0193949	A1	8/2011	Nambakam et al.
2011/0195701	A1	8/2011	Cook et al.
2011/0213210	A1	9/2011	Temby et al.
2011/0218674	A1	9/2011	Stuart et al.
2011/0245973	A1	10/2011	Wang et al.
2011/0280551	A1	11/2011	Sammon
2011/0292193	A1	12/2011	Wang et al.
2011/0301759	A1	12/2011	Wang et al.
2011/0306400	A1	12/2011	Nguyen
2012/0023506	A1	1/2012	Maeckel et al.
2012/0036484	A1	2/2012	Zhang et al.
2012/0059946	A1	3/2012	Wang
2012/0072023	A1	3/2012	Ota
2012/0072024	A1	3/2012	Wang et al.
2012/0092157	A1	4/2012	Tran
2012/0095352	A1	4/2012	Tran
2012/0113856	A1	5/2012	Krishnaswamy
2012/0191246	A1	7/2012	Roe et al.
2012/0191464	A1	7/2012	Stuart et al.
2012/0203731	A1	8/2012	Nelson et al.
2012/0291809	A1	11/2012	Kuhe et al.
2013/0250938	A1	9/2013	Anandakumar et al.
2014/0047022	A1	2/2014	Chan et al.
2014/0085543	A1	3/2014	Hartley et al.
2014/0135990	A1	5/2014	Stuart et al.
2014/0139616	A1	5/2014	Pinter et al.
2014/0155755	A1	6/2014	Pinter et al.

FOREIGN PATENT DOCUMENTS

CN	1404695	A	3/2003
CN	1554193	A	12/2004
CN	1554985	A	12/2004
CN	1561923	A	1/2005
CN	1743144	A	3/2006
CN	101049017	A	10/2007
CN	101106939	A	1/2008
CN	101151614	A	3/2008
CN	100407729	C	7/2008
CN	101390098	A	3/2009
CN	101507260	A	8/2009
CN	101730894	A	6/2010
CN	101866396	A	10/2010
CN	101978365	A	2/2011
CN	102203759	A	9/2011
CN	101106939	B	11/2011
EP	92/466492	A2	1/1992
EP	92/488673	A2	6/1992
EP	981905	B1	1/2002
EP	2002/1262142	A2	12/2002
EP	1304872	A1	4/2003
EP	2004/1536660	A3	9/2004
EP	2005/1536660	A2	6/2005
EP	2005/1573406	A2	9/2005
EP	2005/1594660	A2	11/2005
EP	1763243	A2	3/2007
EP	2007/1791464	A2	6/2007
EP	2007/1800476	A2	6/2007
EP	1819108	A2	8/2007
EP	2007/1856644	A2	11/2007
EP	2008/1928310	A2	6/2008
EP	1232610	B1	1/2009
EP	2009/2027716	A2	2/2009
EP	2010/2145274	A1	1/2010
EP	2010/2214111	A2	8/2010
EP	2010/2263158	A2	12/2010
EP	2011/2300930	A2	3/2011
EP	2011/2342651	A2	7/2011
GB	2431261	A	4/2007
JP	07-194609	A	8/1995
JP	95/7213753	A	8/1995
JP	95/7248823	A	9/1995
JP	7-257422	A	10/1995
JP	8-84328	A	3/1996
JP	96/8320727	A	12/1996
JP	97/9267276	A	10/1997
JP	10079097	A	3/1998
JP	10288689	A	10/1998
JP	11220706	A	8/1999
JP	2000-032319	A	1/2000
JP	2000-049800	A	2/2000
JP	2000/079587	A	3/2000
JP	2000/196876	A	7/2000
JP	2001/188124	A	4/2001
JP	2001/125641	A	5/2001
JP	2001/147718	A	5/2001
JP	2001/179663	A	7/2001
JP	2001/198865	A	7/2001
JP	2001/198868	A	7/2001
JP	2001/199356	A	7/2001
JP	2002/000574	A	1/2002
JP	2002/046088	A	2/2002
JP	2002/235423	A	2/2002
JP	2002/112970	A	4/2002
JP	2002/101333	A	5/2002
JP	2002-305743	A	10/2002
JP	2002321180	A	11/2002
JP	2002/355779	A	12/2002
JP	2004181229	A	7/2004
JP	2004/524824	T	8/2004
JP	2004/261941	A	9/2004
JP	2004/289379	A	10/2004
JP	2005/028066	A	2/2005
JP	2005/059170	A	3/2005
JP	2005111083	A	4/2005
JP	2006/508806	A	3/2006
JP	2006/109094	A	4/2006
JP	2006/224294	A	8/2006
JP	2006/246438	A	9/2006
JP	2007-007040	A	1/2007
JP	2007/081646	A	3/2007
JP	2007-232208	A	9/2007
JP	2007-316966	A	12/2007
JP	2009125133	A	6/2009
JP	2010/64154	A	3/2010
JP	2010/532109	A	9/2010
JP	2010/246954	A	11/2010
KR	2006/0037979	A	5/2006
KR	2009/0012542	A	2/2009
KR	2010/0019479	A	2/2010
KR	2010/0139037	A	12/2010
WO	93/06690	A1	4/1993
WO	9742761	A1	11/1997
WO	98/051078	A1	11/1998
WO	99/067067	A2	12/1999
WO	2000/025516	A1	5/2000
WO	2000/033726	A3	6/2000
WO	2001/031861	A1	5/2001
WO	2003/077745	A1	9/2003
WO	2004/008738	A1	1/2004
WO	2004/012018	A2	2/2004
WO	2004/075456	A2	9/2004
WO	2006/012797	A1	2/2006
WO	2006/078611	A1	4/2006
WO	2006044847	A2	4/2006
WO	2007/041295	A1	4/2007
WO	2007/041295	A2	4/2007
WO	2007/041038	A1	6/2007
WO	2008/100272	A2	8/2008
WO	2008/100272	A3	10/2008

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	2009/117274	A2	9/2009
WO	2009/128997	A1	10/2009
WO	2009/145958	A2	12/2009
WO	2010/006205	A1	1/2010
WO	2010/006211	A1	1/2010
WO	2010/033666	A1	3/2010
WO	2010/047881	A1	4/2010
WO	2010/062798	A1	6/2010
WO	2010/065257	A1	6/2010
WO	2010/120407	A1	10/2010
WO	2011/028589	A2	3/2011
WO	2011/028589	A3	4/2011
WO	2011/097130	A2	8/2011
WO	2011/097132	A2	8/2011
WO	2011/109336	A2	9/2011
WO	2011/097132	A3	12/2011
WO	2011/149902	A2	12/2011

OTHER PUBLICATIONS

Applebome, "Planning Domesticated Robots for Tomorrow's Household", New York Times, http://www.theoldrobots.com/images17/dc17.JPG, Mar. 4, 1982, pp. 21,23.

Barrett, "Video Conferencing Business Soars as Companies Cut Travel; Some Travel Cuts Are Permanent", http://www.ivci.com/international_videoconferencing_news_videoconferencing_news_19.html, Mar. 13, 2002.

Bartholomew, "An Apothecary's Pharmacy", http://classes.bnf.fr/ema/grands/034.htm, National Library of France, BnF—Teaching Kit—Childhood in the Middle Ages, Encyclopedic reference entry from Bartholomew of England, Book of the Properties of Things, France, Late XVth Century Paris, BnF, Manuscripts Department, 218 French, fol. 111, no date.

Bischoff, "Design Concept and Realization of the Humanoid Service Robot Hermes", Field and Service Robotics, Springer, London, 1998, pp. 485-492.

Blackwell, "Video: A Wireless LAN Killer App?", Internet, Apr. 16, 2002 pp. 1-3.

Brooks, "A Robust Layered Control System for a Mobile Robot," IEEE Journal of Robotics and Automation, 2 (1), Mar. 1986, 10 pgs.

Cheetham, et al., "Interface Development for a Child's Video Conferencing Robot", 2000, pp. 1-4.

Crowley, "Hello to Our Future", AARP Bulletin, http://www.cs.cmu.ed/-nursebot/web/press/aarp 99_14/millennium.html, Jan. 2000.

Dalton, "Techniques for Web Telerobotics", PhD Thesis, University of Western Australia, http://telerobot.mech.uwa.edu.au/information.html, http://catalogue.library.uwa.edu.au/search, 2001, pp. 27-62 149-191.

Davis, "Meet iRobot, The Smartest Webcam on Wheels," Wired Magazine, 8.09, http://www.wired.com/wired/archive/8.09/irobot_pr.html, Sep. 2000, 2 pgs.

Dean, et al., "1992 AAAI Robot Exhibition and Competition," AI Magazine, Spring 1993, 10 pgs.

"Defendant VGo Communications, Inc.'s Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order", May 2, 2012.

"Defendant-Counterclaimant VGo Communications, Inc.'s Supplemental Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order", May 14, 2012.

Discovery Channel Canada, "Inventing the Future: 2000 Years of Discovery", http://www.sfwriter.com/pritf.htm, (Video Transcript), Jan. 2, 2000.

Dudenhoeffer, et al., "Command and Control Architectures for Autonomous Micro-Robotic Forces", http://www.inl.gov/technicalpublications/Documents/3157051.pdf, Apr. 2001.

Elhajj, et al., "Synchronization and Control of Supermedia Transmission Via the Internet", Proceedings of 2001 International Symposium on Intelligent Multimedia Video and Speech Processing., Hong Kong, May 2-4, 2001.

Elhajj, "Real-Time Haptic Feedback in Internet-Based Telerobotic Operation", IEEE International Conference on Electro/Information Technology, http://www.egr.msu.edu/~ralab-web/cgi_bin/internet-teleoperation.php, Jun. 2000.

Fels, "Developing a Video-Mediated Communication System for Hospitalized Children", Telemedicine Journal, vol. 5, No. 2, 1999.

Fiorini, et al., "Health Care Robotics: A Progress Report", IEEE International Conference on Robotics and Automation, 1997., Apr. 1997, pp. 1271-1276.

Fong, "Collaborative Control: A Robot-Centric Model for Vehicle Teleoperation", The Robotics Institute Carnegie Mellon University, http://web.archive.org/web/20030504040803/www.ricmu.edu/cgi-bin/tech_reports.cgi?year=2001&text=0, Nov. 2001.

Ghiasi, et al., "A Generic Web-based Teleoperations Architecture: Details and Experience", SPIE Conference on Telemanipulator and Telepresence Technologies VI, Sep. 1999.

Goldberg, "Desktop Teleoperation via the World Wide Web, Proceedings of the IEEE International Conference on Robotics and Automation", http://citeseer.ist.osu.edu/cache/oaoers/cs/5/fto:zSzzSzusc.eduzSzoubzSziriszSzraiders.odf/aol, 1995, pp. 654-659.

Goldenberg, et al., "Telemedicine in Otolaryngology", American Journal of Otolaryngology vol. 23,No. 1, 2002 , pp. 35-43.

Grow, "Office Coworker Robot," Time Magazine, http://www.time.com/time/specials/packages/article/0,28804,1936165_1936255_1936640,00.html, Nov. 19, 2001, 2 pgs.

Hameed, et al., "A Review of Telemedicine", Journal of Telemedicine and Telecare., vol. 5, Supplement 1, 1999, pp. S1:103-S1:106.

Han, et al., "Construction of an Omnidirectional Mobile Robot Platform Based on Active Dual-Wheel Caster Mechanisms and Development of a Control Simulator", Kluwer Acedemic Publishers, vol. 29, Nov. 2000, pp. 257-275.

Handley, et al., "RFC 2327—SDP: Session Description Protocol", http://www.faqs.org/rfcs/rfc2327.html. Apr. 1998.

Hanebeck, et al., "Roman: A mobile Robotic Assistant for Indoor Service Applications", Proceedings of the 1997 IEEE/RSJ International Conference on Intelligent Robots and Systems, 1997.

Haule, et al., "Control Scheme for Delayed Teleoperation Tasks", Proceedings of the Pacific Rim Conference on Communications, Computer and Signal Processing, May 17, 1995.

Holmberg, "Development of a Holonomic Mobile Robot for Mobile Manipulation Tasks", International Conference on Field and Service Robotics, Pittsburgh, PA, Aug. 1999.

Ishiguro, "Integrating a Perceptual Information Infrastructure with Robotic Avatars: A Framework for Tele-Existence", Proceeding of IEEE Conference on Intelligent Robots and Systems, 1999, pp. 1032-1038.

ITU, "ITU-T H.281 A Far End Camera Control Protocol for Videoconferences using H.224", http://www.itu.int/rec/T-RECH.281-199411-I/en, Nov. 1994.

ITU, "ITU-T H.323 Packet-based multimedia communications", http://www.itu.int/rec/T-REC-H.323-199802-S/en, Feb. 1998.

ITU, "ITU-T H.450.11 Call Intrusion Supplementary Service for H.323", http://www.itu.int/rec/T-RECH.450.11-200103-I/en, Mar. 2001.

ITU, "ITU-T H.450.9 Call Completion Supplementary Services for H.323", http://www.itu.int/rec/T-RECH.450.9-200011-I/en, Nov. 2000.

Jenkins, et al., "Telehealth Advancing Nursing Practice", Nursing Outlook, vol. 49, No. 2, Mar./Apr. 2001.

Keller, et al., "Raven Interface Project", Fall 2001, http://upclose.lrdc.pitt.edu/people/louw_assets/Raven_Slides.pps , Fall 2001.

Khatib, "Robots in Human Environments", Proc. International Conference on Control, Automation, Robotics, and Vision ICRACV2000, Singapore, Dec. 2000, pp. 454-457.

Knight, et al., "Active Visual Alignment of a Mobile Stereo Camera Platform", Proceedings of the IEEE, International Conference on Robotics and Automation, San Francisco, Apr. 24-28, 2000, pp. 3202-3208.

Lane, "Automated Aides", Newsday, http://www.cs.cum.edu/nursebot/web/press/nd4380.htm, Oct. 17, 2000.

Lee, et al., "A novel method of surgical instruction: International telementoring", Internet, 1998, pp. 1-4.

(56) **References Cited**

OTHER PUBLICATIONS

Long, "HelpMate Robotics, Inc. (Formerly Transitions Research Corporation) Robot Navigation Technology", NIST Special Publication, http://www.atp.nist.gov/eao/sp950-1/helpmate.htm, Mar. 1999, pp. 950-951.
Luna, "Robot a new face on geriatric care", OC Register, 8-6, 2003.
Mair, "Telepresence—The Technology. And Its Economic and Social Implications", IEEE Technology and Society, 1997.
Meng, et al., "E-Service Robot in Home Healthcare", Proceedings of the 2000 IEEE/RSJ, International Conference on Intelligent Robots and Systems, 2000, pp. 832-837.
Metz, "HP Labs", PCMAG.com, http://www.pcmag.com/article2/0,2817,1130820,00.asp, Jul. 1, 2003.
Michaud, "Introducing Nursebot", The Boston Globe, http://www.cs.cmu.edu/nursebot/web/press/globe 3 01/index.html, Sep. 11, 2001, pp. 1-5.
Montemerlo, "Telepresence: Experiments in Next Generation Internet", CMU Robotics Institute, http://www.ri.cmu.edu/creative/archives.htm (Video/Transcript), Oct. 20, 1998.
Murphy, "Introduction to A1 Robotics", A Bradford Book, 2000, p. 487.
Nomadic Technologies Inc., "Nomad XR4000 Hardware Manual", Release 1.0, Mar. 1999.
Nt'L Energy Res Sci Comp Ctr, "Berkeley Lab's RAGE Telepresence Robot Captures R&D100 Award", http://www.nersc.gov/news/newsroom/RAGE070202.php, Jul. 2, 2002.
Ogata, et al., "Emotional Communication Robot: WAMOEBA-2R—Emotion Model and Evaluation Experiments", Internet, 1999, pp. 1-16.
Oh, et al., "Autonomous Battery Recharging for Indoor Mobile Robots", Proceedings of Australian Conference on Robotics and Automation, http://users.rsise.anu.edu.au/rsl/rsl_papers/ACRA2000/Auto_Recharge_Paper. pdf, 2000.
Paulos, "Designing Personal Tele-embodiment", IEEE International Conference on Robotics and Automation http://www.prop.org/papers/icra98.pdf, 1998.
Paulos, "PRoP: Personal Roving Presence", ACM:CHI Proceedings of CHI '98, http://www.prop.org/papers/chi98.pdf, 1998, p. 6.
Paulos, "Video of PRoP 2 at Richmond Field Station", www.prop.org Printout of Home Page of Website and two-page Transcript of the audio portion of said PRoP Video, May 2001.
"PictureTel Adds New Features and Functionality to Its Award-Winning Live200 Desktop Videoconferencing System", PR Newswire Association, LLC, Gale, Cengage Learning, http://www.thefreelibrary.com/PictureTel+Adds+New+Features+And+Functionality+To+Its+Award-Winning . . . -a019512804, Jun. 13, 1997.
Picturetel, "PictureTel Live200 for Windows NT Product Guide", http://support.polycom.com/global/documents/support/user/products/video/live200_live200NT_product_guide.pdf, Nov. 1994.
Roach, "Automatic Call Back Service in SIP", http://tools.ietf.org/pdf/draftroach-sip-acb-00.pdf, Mar. 2000.
Rovetta, et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and and optical fiber Networks for Data Exchange", International Journal of Robotics Research, Jun. 1, 1996, pp. 267-279.
Schaeffer, "Care-O-bot: A System for Assisting Elderly or Disabled Persons in Home Environments", Proceedings of AAATE-99, http://morpha.de/download/publications/IPA, 1999.
Schulz, et al., "Web Interfaces for Mobile Robots in Public Places", Robotics & Automation Magazine, IEEE, vol. 7, Issue 1, Mar. 2000, pp. 1-9.
Siegwart, "Interacting Mobile Robots on the Web", Proceedings of the 1999 IEEE International Conference on Robotics and Automation, May 1999.
Simmons, "Xavier: An Autonomous Mobile Robot on the Web", IEEE Robotics and Automation Magazine, 1999, pp. 43-48.
Spawar Systems Center, "Robart", San Diego, CA, http://www.nosc.mil/robots/land/robart/robart.html, 1998, pp. 1-8.
Summers, "Microsoft NetMeeting 3 Features excerpt from Official Microsoft NetMeeting 3.0 Book", http://technet.microsoft.com/en-us/library/cc723477.aspx#XSLTsection121121120120, excerpt from Microsoft Press http://www.computerbooksonline.com/abook.asp?i=0735605823, Mar. 1999.
Suplee, "Mastering the Robot", The Washington Post, http://www.cs.cmu.edu-nursebotlweb/press/wash/index.html, Sep. 17, 2000, p. A01.
Tahboub, et al., "Dynamics Analysis and Control of a Holonomic Vehicle With Continously Variable Transmission", Journal of Dynamic Systems, Measurement and Control ASME vol. 124, Mar. 2002, pp. 118-126.
U.S. Appl. No. 10/783,760, filed Feb. 20, 2004, Wang, et al., 48 pgs.
U.S. Appl. No. 60/449,762, filed Feb. 24, 2003, Wang, et al., 28 pgs.
Weiss, et al., "Pebbles: A Personal Technology for Meeting Education, Social and Emotional Needs of Hospitalised Children", Personal and Ubiquitous Computing 5, Springer-Verlag London Ltd., 2001, pp. 157-168.
West, et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design , vol. 119, Jun. 1997, pp. 153-161.
Yamauchi, "PackBot: A Versatile Platform for Military Robotics", Internet, 2004, pp. 1-10.
Zambroski, "CMU, Pitt Developing 'nursebot'", http://www.cs.cmu.edu/~nursebot/web/press/tribunereview.html, Oct. 27, 2000.
Zamrazil, "Telemedicine in Texas: Public Policy Concerns", House Research Organization Focus Report, Texas House of Representatives, http://www.hro.house.state.tx.us/focus/telemed.pdf, May 5, 2000, pp. 76-22.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. I of IV, Jun. 24, 2013, pp. A1-A6357.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. II of IV, Jun. 24, 2013, pp. A6849-A10634.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. III of IV, Jun. 24, 2013, pp. A10654-A15517.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. IV of IV, Jun. 24, 2013, pp. A15677-A18127.
Reply Brief for Defendant-Appellee VGO Communications, Inc., Appeal from the U.S. District Court for the Central District of California, in Case No. 2:11-cv-9185, Judge Percy Anderson, May 28, 2013, 75 pages.
Civil Minutes-General: Case No. CV 11-9185PA (AJWx), *InTouch Tech., Inc.* v. *VGo Commons, Inc.*, U.S. District Court for the Central District of California, Judge Percy Anderson, Sep. 10, 2012, 7 pages.
"Magne Charge", Smart Power for Electric Vehicles, General Motors Corporation, Serial No. 75189637, Registration No. 2114006, Filing Date: Oct. 29, 1996, Aug. 26, 1997, 2 pages.
"More Online Robots: Robots that Manipulate", available online at <http://ford.ieor.berkeley.edu/ir/robots_a2.html>, retrieved on Nov. 23, 2010, Aug. 2001, 2 pages.
Opening Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Apr. 12, 2013, 187 pages.
Reply Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Jun. 14, 2013, 39 pages.
"Using your Infrared Cell Phone Camera", available online on <http://www.catsdomain.com/xray/about.htm>, retrieved on Jan. 23, 2014, Courtesy of Internet Wayback Machine, Jan. 30, 2010, 4 pages.
Office Action received for Chinese Patent Application No. 200680044698.0 dated Nov. 4, 2010. (9 pages of Official Copy and 17 pages of English Translation).
Active Media, Inc., "Saphira Software Manual", Real World, Saphira Version 5.3, 1997, 105 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Activmedia Robotics LLC, "Pioneer 2/PeopleBot™", Operations Manual, Version 9, Oct. 2001, 78 pages.
Adams, Chris, "Simulation of Adaptive Behavior (SAB'02)—From Animals to Animats 7", Mobile Robotics Research Group, The Seventh International Conference, available online at: <http://www.dai.ed.ac.uk/groups/mrg/MRG.html>, retrieved on Jan. 22, 2014, Aug. 4-11, 2002, 1 page.
Ando et al., "A Multimedia Self-Service Terminal with Conferencing Functions", Proceedings of 4th IEEE International Workshop on Robot and Human Communication, RO-MAN'95, Jul. 5-7, 1995, pp. 357-362.
Apple Inc., "I Phone", iPhone Series, XP002696350, Sep. 21, 2012, pp. 1-29.
Bar-Cohen et al., "Virtual Reality Robotic Telesurgery Simulations Using MEMICA Haptic System", Proceedings of SPIE's 8th Annual International Symposium on Smart Structures and Materials, Mar. 5-8, 2001, 8 pages.
Bauer et al., "Remote Telesurgical Mentoring: Feasibility and Efficacy", IEEE, Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000, pp. 1-9.
Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", BonSecours Health System, Inc., Technology Ealy Warning System, Jun. 2003, pp. 1-10.
Blaer et al., "TopBot: Automated Network Topology Detection With a Mobile Robot", IEEE, Proceedings of the 2003 International Conference on Robotics and Automation, Taipei, Taiwan, Sep. 14-19, 2003, pp. 1582-1587.
Bradner, S., "The Internet Standards Process—Revision 3", Network Working Group, Request for Comments: 2026, BCP: 9, Obsoletes: 1602, Category: Best Current Practice, Oct. 1996, pp. 1-36.
Breslow et al., "Effect of a Multiple-Site Intensive Care Unit Telemedicine Program on Clinical and Economic Outcome an Alternative Paradigm for Intensivist Staffing", Critical Care Med., vol. 32, No. 1, Jan. 2004, pp. 31-38.
Brooks, Rodney Allen, "Flesh and Machines: How Robots Will Change Us", available online at <http://dl.acm.org/citation.cfm?id=560264&preflayout=flat%25202%2520of>, retrieved on Nov. 23, 2010, Feb. 2002, 3 pages.
Celt et al., "The eICU: It's Not Just Telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001, pp. 183-189.
Christensen et al., "BeeSoft User's Guide and Reference", Robots for the Real World™, Real World Interface, Inc ., Sep. 26, 1997, 203 pages.
Chu et al., "Detection of Target Mobile Signal Strength", Technical Development, Motorola Inc., Jan. 1999, pp. 205-206.
Cleary et al., "State of the Art in Surgical Robotics: Clinical Applications and Technology Challenges", Computer Aided Surgery, Nov. 2001, pp. 1-26.
CNN, "Floating 'Droids' to Roam Space Corridors of the Future", available online at <http://edition.cnn.com/2000/TECH/space/01/12/psa/> retrieved on Nov. 11, 2010., Jan. 12, 2000, 3 pages.
CNN.com, "Paging Dr. Robot: Machine Helps Doctors with Patients", available online at <http://edition.cnn.com/2003/TECH/ptech/09/29/doctor.robot.ap/index.html>, retrieved on Sep. 30, 2003, 3 pages.
Dario et al., "A Robot Workstation for Diagnosis and Physical Therapy", IEEE Catalog No. 88TH0234-5, Centro "E. Piaggio" University of Pisa, Italy, 1989, pp. 67-72.
Davies, Brian, "Robotics in Minimally Invasive Surgery", Mechatronics in Medicine Lab, Dept. Mechanical Engineering, Imperial College, London SW7 2BX, The Institution of Electrical Engineers, IEE, Savoy Place, London WC2R OBL, UK, 1995, pp. 1-2.
Digiorgio, James, "Is Your Emergency Department of the Leading Edge?", Chicago Hospital News, vol. 2, No. 12, Feb. 2005, 3 pages.
Elhajj et al., "Supermedia in Internet-Based Telerobotic Operations", Lecture Notes in Computer Science, vol. 2216, 2001, pp. 359-372.
Ellison et al., "Telerounding and Patient Satisfaction after Surgery", American College of Surgeons, Elsevier, Inc., vol. 199, No. 4, Oct. 2004, pp. 523-530.
Evans et al., "HelpMate: The Trackless Robotic Courier", PYXIS, available online at <http://www.pyxis.com/>, 3 pages.
Fetterman, David M., "Videoconferencing Over the Internet", Qualitative Health Journal, vol. 7, No. 1, May 1966. pp. 154-163.
Gaidioz et al., "Synchronizing Network Probes to Avoid Measurement Intrusiveness with the Network Weather Service", High-Performance Distributed Computing, Proceedings of the Ninth International Symposium, 2000, pp. 147-154.
Garner et al., "The Application of Telepresence in Medicine", BT Technology Journal, vol. 15, No. 4, Oct. 1, 1997, pp. 181-187.
Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation (ICRA), vol. 2, San Francisco, California, 2000, pp. 2019-2024.
Goldman, Lea, "Machine Dreams", available online at <http://www.forbes.com/global/2002/0527/043.html>, retrieved on Nov. 23, 2010., May 27, 2002, 5 pages.
Gostai "Gostai Jazz: Robotic Telepresence", available online at <http://www.gostai.com>, 4 pages.
Gump, Michael D., "Robot Technology Improves VA Pharmacies", U.S. Medicine Informational Central, Jul. 2001, 3 pages.
Harmo et al., "Moving Eye—Interactive Telepresence over Internet with a Ball Shaped Mobile Robot", Automation Technology Laboratory, Helsinki University of Technology, 2000, 6 pages.
Hees, William P., "Communications Design for a Remote Presence Robot", CSCI E-131B, Final Project, Jan. 14, 2002, 12 pages.
Herias et al., "Flexible Virtual and Remote Laboratory for Teaching Robotics", Formatex 2006, Proceedings of Advance in Control Education Madrid, Spain, Jun. 2006, pp. 1959-1963.
Ishihara et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Proceedings of IEEE/RSJ International Workshop on Intelligent Robots and Systems, vol. 2, Nov. 3-5, 1991, pp. 1145-1150.
Ivanova, Natali, "Internet Based Interface for Control of a Mobile Robot", First Degree Programme in Mathematics and Computer Science, Master•s thesis, Department of Numerical Analysis and Computer Science, 2003, 59 pages.
Jacobs et al., "Applying Telemedicine to Outpatient Physical Therapy", AMIA, Annual Symposium Proceedings, 2002, 1 page.
Johanson, Mathias, "Supporting Video-Mediated Communication over the Internet", Thesis for the degree of Doctor of Philosophy, Department of Computer Engineering, Chalmers University of Technology, Gothenburg, Sweden, 2003, 222 pages.
Osborn et al., "Quality of Life Technology Center", QoLT Research Overview: A National Science Foundation Engineering Research Center, Carnegie Mellon University of Pittsburgh, 2 pages.
Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", available online at <http://www.w3.org/Conferences/WWW4/Papers/326/>, retrieved on Nov. 23, 2010, 1995, 15 pages.
Paulos et al., "Ubiquitous Tele-Embodiment: Applications and Implications", International Journal of Human Computer Studies, vol. 46, No. 6, Jun. 1997, pp. 861-877.
Paulos et al., "Designing Personal Tele-Embodiment", Proceedings of IEEE International Conference on Robotics and Automation, vol. 4, May 16-20, 1998, pp. 3173-3178.
Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE Transactions on Robotics and Automation, vol. 10, No. 4, Aug. 1994, pp. 480-489.
Piquepaille, Roland, "How New Technologies are Modifying Our Way of Life", Roland Piquepaille's Technology Trends, This Blog and its RSS Feed Are Moving, Oct. 31, 2004, 2 pages.
Radvision, "Making Sense of Bandwidth the NetSense Way", Network Congestion in Unmanaged Networks Bandwidth Estimation and Adaptation Techniques, Radvision's Netsense Technology, 2010, 7 pages.
Reynolds et al., "Review of Robotic Telemedicine Utilization in Intensive Care Units (ICUs)", 11th Annual ATA Symposium, Tampa, Florida, 2011, 1 page.

(56) **References Cited**

OTHER PUBLICATIONS

Rovetta et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and Optical Fiber Networks for Data Exchange", International Journal of Robotics Research, vol. 15, No. 3, Jun. 1, 1996, pp. 267-279.
Roy et al., "Towards Personal Service Robots for the Elderly", Workshop on Interactive Robots and Entertainment (WIRE 2000), vol. 25, Apr. 30-May 1, 2000, 7 pages.
Salemi et al., "MILO: Personal Robot Platform", IEEE/RSJ International Conference on Intelligent Robots and Systems, Aug. 2005, pp. 4089-4094.
Jouppi et al., "BiReality: Mutually-Immersive Telepresence", Multimedia '04, Proceedings of the 12th Annual ACM International Conference on Multimedia, Oct. 10-16, 2004, pp. 860-867.
Jouppi et al., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Proceedings of the ACM conference on Computer Supported Cooperative Work, Nov. 16-20, 2002, pp. 354-363.
Kanehiro et al., "Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting", Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, Oct. 29-Nov. 3, 2001, pp. 1093-1099.
Kaplan et al., "An Internet Accessible Telepresence", Multimedia Systems Journal, vol. 5, 1996, 7 pages.
Kurlowicz et al., "The Mini Mental State Examination (MMSE)", The Hartford Institute for Geriatric Nursing, Journal of Psychiatric Research, No. 3, Jan. 1999, 2 pages.
Kuzuoka et al., "Can the GestureCam be a Surrogate?", Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work, Sep. 10-14, 1995, pp. 181-196.
Leifer et al., "VIPRR: A Virtually in Person Rehabilitation Robot", Proceedings of 1997 International Conference on Rehabilitation Robotics, Apr. 14-15, 1997, 4 pages.
Lemaire, Edward, "Using Communication Technology to Enhance Rehabilitation Services", Terry Fox Mobile Clinic, The Rehabilitation Centre, Ottawa, Canada, Version 2.0, 1998-2001, 104 pages.
Lim et al., "Control to Realize Human-Like Walking of a Biped Humanoid Robot", Systems, Man and Cybernetics, IEEE International Conference, vol. 5, 2000, pp. 3271-3276.
Linebarger et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Department of Computer Science and Engineering; Lehigh University, vol. 13, 2004, 40 pages.
Sachs et al., "Virtual Visit™: Improving Communication for Those Who Need it Most", Studies in Health Technology and Informatics, vol. 94, Medicine Meets Virtual Reality 11, 2003, pp. 302-308.
Mack, Michael J., "Minimally Invasive and Robotic Surgery", The Journal of the American Medical Association, vol. 285, No. 5, Feb. 7, 2001, pp. 568-572.
Martin, Anya, "Brighter Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.
McCardle et al., "The Challenge of Utilizing New Technology in Design Education", Loughborough University, IDATER, 2000, pp. 122-127.
Minsky, Marvin, "Telepresence", OMNI Magazine, Jun. 1980, 6 pages.
Nakajima et al., "A Multimedia Teleteaching System using an Electronic Whiteboard for Two-Way Communication of Motion Videos and Chalkboards", Robot and Human Communication, Proceedings of 2nd IEEE International Workshop, 1993, pp. 436-441.
Nakazato et al., "Group-Based Interface for Content-Based Image Retrieval", Proceedings of the Working Conference on Advanced Visual Interfaces, 2002, pp. 187-194.
Nakazato et al., "Group-Oriented User Interface for Digital Image Management", Journal of Visual Languages and Computing, vol. 14, No. 4, Aug. 2003, pp. 45-46.
Noritsugu et al., "Application of Rubber Artificial Muscle Manipulator as a Rehabilitation Robot", Mechatronics, IEEE/ASME Transactions, vol. 2, No. 4, Dec. 1997, pp. 259-267.
North, Michael, "Telemedicine: Sample Script and Specifications for a Demonstration of Simple Medical Diagnosis and Treatment Using Live Two-Way Video on a Computer Network", Greenstar Corporation, 1998, 5 pages.
Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2R—Experimental evaluation of the Emotional Communication between Robots and Humans", Proceedings of the 2000 IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, 2000, pp. 175-180.
Ojha, Anand K., "An application of Virtual Reality in Rehabilitation", Proceedings of the 1994 IEEE Southeastcon Creative Technology Transfer, A Global Affair, Apr. 1994, pp. 4-6.
Paulos et al., "Personal Tele-Embodiment", Dissertation, Doctor of Philosophy in Computer Science in the Graduate Division of the University of California at Berkeley, 2001, 282 pages.
Sandt et al., "Perceptions for a Transport Robot in Public Environments", Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, Sep. 7-11, 1997, pp. 360-365.
Shimoga et al., "Touch and Force Reflection for Telepresence Surgery", Proceedings of the 16th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Nov. 1994, pp. 1049-1050.
Stephenson, Gary, "Dr. Robot Tested at Hopkins", Johns Hopkins Medical institutions, available online at <http://www.hopkinsmedicine.org/press/2003/august/030805.htm>, Aug. 5, 2003, 2 pages.
Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Complications of Urologic Laparoscopic Surgery: Recognition, Management and Prevention, Dec. 2002, 17 pages.
Telepresence Research, Inc., "Telepresence Mobile Robot System", available online at <http://www.telepresence.com/telepresence-research/TELEROBOT/>, retrieved on Nov. 23, 2010, Feb. 20, 1995, 3 pages.
Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", Proceedings of the 19th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, vol. 6, Oct. 30-Nov. 2, 1997, pp. 2771-2776.
Theodosiou et al., "MuLVAT: A Video Annotation Tool Based on XML-Dictionaries and Shot Clustering", 19th International Conference, Artificial Neural Networks—ICANN, Sep. 14-17, 2009, pp. 913-922.
Thrun et al., "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", Journal of Robotics Research, vol. 19, 2000, pp. 1-35.
Tipsuwan et al., "Gain Adaptation of Networked Mobile Robot to Compensate QoS Deterioration", vol. 4, 28th Annual Conference of the Industrial Electronics Society, Nov. 5-8, 2002, pp. 3146-3151.
Tsui et al., "Exploring Use Cases for Telepresence Robots", 6th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Mar. 2011, 7 pages.
Tyrrell et al., "Teleconsultation in Psychology: The Use of Videolinks for Interviewing and Assessing Elderly Patients", British Geriatrics Society, Age and Ageing, vol. 30, No. 3, May 2001, pp. 191-195.
Tzafestas et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", Technical Report DEMO 2000/13, Institute of Informatics and Telecommunications, National Center for Scientific Research "Demokritos", Athens, Greece, Nov. 2000, pp. 1-23.
UMASS Lowell Robotics Lab, "Robotics Lab @ UMASS Lowell", Department of Computer Science, Brochure, 2011, 2 pages.
Urquhart, Kim, "InTouch's Robotic Companion 'Beams Up' Healthcare Experts", Medical Device Daily, The Daily Medical Technology Newspaper, vol. 7, No. 39, Feb. 27, 2003, pp. 1-4.
Video Middleware Cookbook, "H.350 Directory Services for Multimedia", 4 pages.
Weaver et al., "Monitoring and Controling Using the Internet and Java", Proceedings of the 25th Annual Conference of the IEEE Industrial Electronics Society, vol. 3, 1999, pp. 1152-1158.
Weiss et al., "Telework and Video-Mediated Communication: Importance of Real-Time, Interactive Communication for Workers with Disabilities", Available online at <http://www.telbotics.com/research_3.htm>, retrieved on Nov. 23, 2010, 1999, 3 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Yamasaki et al., "Applying Personal Robots and Active Interface to Video Conference Systems", 6th International Conference on Human Computer Interaction, vol. B, 1995, pp. 243-248.
Yong et al., "Robot Task Execution with Telepresence Using Virtual Reality Technology", International Conference on Mechatronic Technology, Nov. 30-Dec. 2, 1998, pp. 1-8.
Zipperer, Lorri, "Robotic Dispensing System", ISMP Medication Safety Alert, vol. 4, No. 17, Aug. 25, 1999, pp. 1-2.
Zorn, Benjamin G., "Ubiquitous Telepresence", Department of Computer Science, University of Colorado, Mar. 18, 1996, 13 pages.
International Search Report Received for International Patent Application No. PCT/US2005/037347, dated Apr. 17, 2006, 2 pages.
International Preliminary Report on Patentability & Written Opinion Received for International Patent Application No. PCT/US2005/037347, dated Apr. 17, 2006, 7 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US2006/037076, dated Apr. 1, 2008, 6 pages.
International Search Report and Written Opinion Received for International Application No. PCT/US2006/037076, dated May 11, 2007, 6 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US/2007/14099, dated Dec. 16, 2008, 5 pages.
International Search Report Received for International Patent Application No. PCT/US2007/14099, dated Jul. 30, 2008, 2 pages.
"Appeal from the U.S. District Court for the Central District of California in No. 11-CV-9185, Judge Percy Anderson", May 9, 2014, pp. 1-48.
"Google translation of: Innovations Report", From research project to television star: Care-O-bot in ZDF series, http://www.innovations-report.de/specials/printa.php?id=5157, Sep. 28, 2001, 2 pages.
"MPEG File Format Summary", downloaded from: http://www.fileformat.info/format/mpeg/egff.htm, Feb. 1, 2001, 8 pages.
"Nomad Scout User's Manual", Nomadic Technologies, Software Version 2. 7, Part No. DOC00004, Jul. 12, 1999, pp. 1-59.
ACM Digital Library Record, "Autonomous Robots vol. 11 Issue 1", downloaded from <http://dl.acm.org/citation.cfm?id=591550&picked=prox&cfid=360891374&cftoken=35225929>, Jul. 2001, 2 pages.
Brenner, "A technical tutorial on the IEEE 802.11 protocol", BreezeCOM Wireless Communications, 1997, pp. 1-24.
CMU Course 16X62, "Robot user's manual", (describing the Nomad Scout), Carnegie Mellon University, Feb. 1, 2001, 11 pages.
Koenen, "MPEG-4: a Powerful Standard for Use in Web and Television Environments", (KPN Research), downloaded from http://www.w3.org/Architecture/1998/06/Workshop/paper26, Jul. 1, 1998, 4 pages.
Library of Congress, "008—Fixed-Length Data Elements (NR)", MARC 21 Format for Classification Data, downloaded from http://www.loc.gov/marc/classification/cd008.html, Jan. 2000, pp. 1-14.
Panusopone, et al., "Performance comparison of MPEG-4 and H.263+ for streaming video applications", Circuits Systems Signal Processing, vol. 20, No. 3, 2001, pp. 293-309.
Paulos, et al., "Personal Tele-Embodiment", Chapter 9 in Goldberg, et al., ed. "Beyond webcams", MIT Press, Jan. 4, 2002, pp. 155-167.
Paulos, "Personal tele-embodiment", OskiCat Catalog Record, UCB Library Catalog, 2001, 3 pages.
Paulos, "Personal Tele-Embodiment", Introductory and cover pages from 2001 Dissertation including Contents table, together with e-mails relating thereto from UC Berkeley Libraries, as shelved at UC Berkeley Engineering Library (Northern Regional library Facility), May 8, 2002, 25 pages, including 4 pages of e-mails.
Paulos, et al., "Social Tele-Embodiment: Understanding Presence", Autonomous Robots, vol. 11, Issue 1, Kluwer Academic Publishers, Jul. 2001, pp. 87-95.
Schraft, et al., "Care-O-bot™: the concept of a system fro assisting elderly or disabled persons in home enviornments", IEEE Proceedings of the 24th Annual Conference of the Industrial Electronics Society, IECON '98, Aug. 31-Sep. 4, 1998, pp. 2476-2481.
Screenshot Showing Google Date for Lemaire Telehealth Manual, Screenshot Retrieved on Dec. 18, 2014, 2 page.
Nomadic Technologies, Inc., "Nomad Scout Language Reference Manual", Software Version: 2.7, Part No. DOC00002, Jul. 12, 1999, 47 pages.
Fulbright et al., "Swami: An Autonomous Mobile Robot for Inspection of Nuclear Waste of Storage Facilities", Autonomous Robots, vol. 2, 1995, 225-235.

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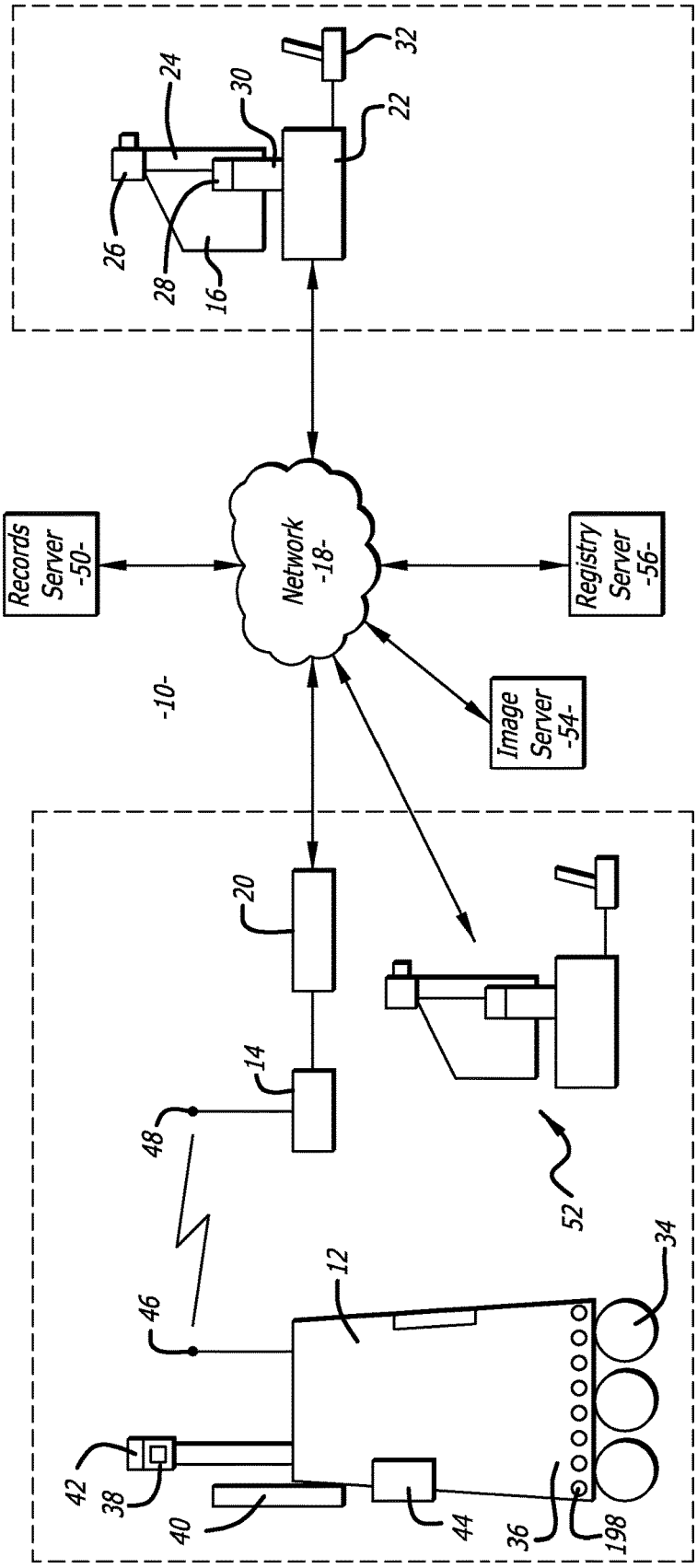
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Network -18-
Registry Server -56-
Image Server -54-
-10-
24
30
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46
12
34
42
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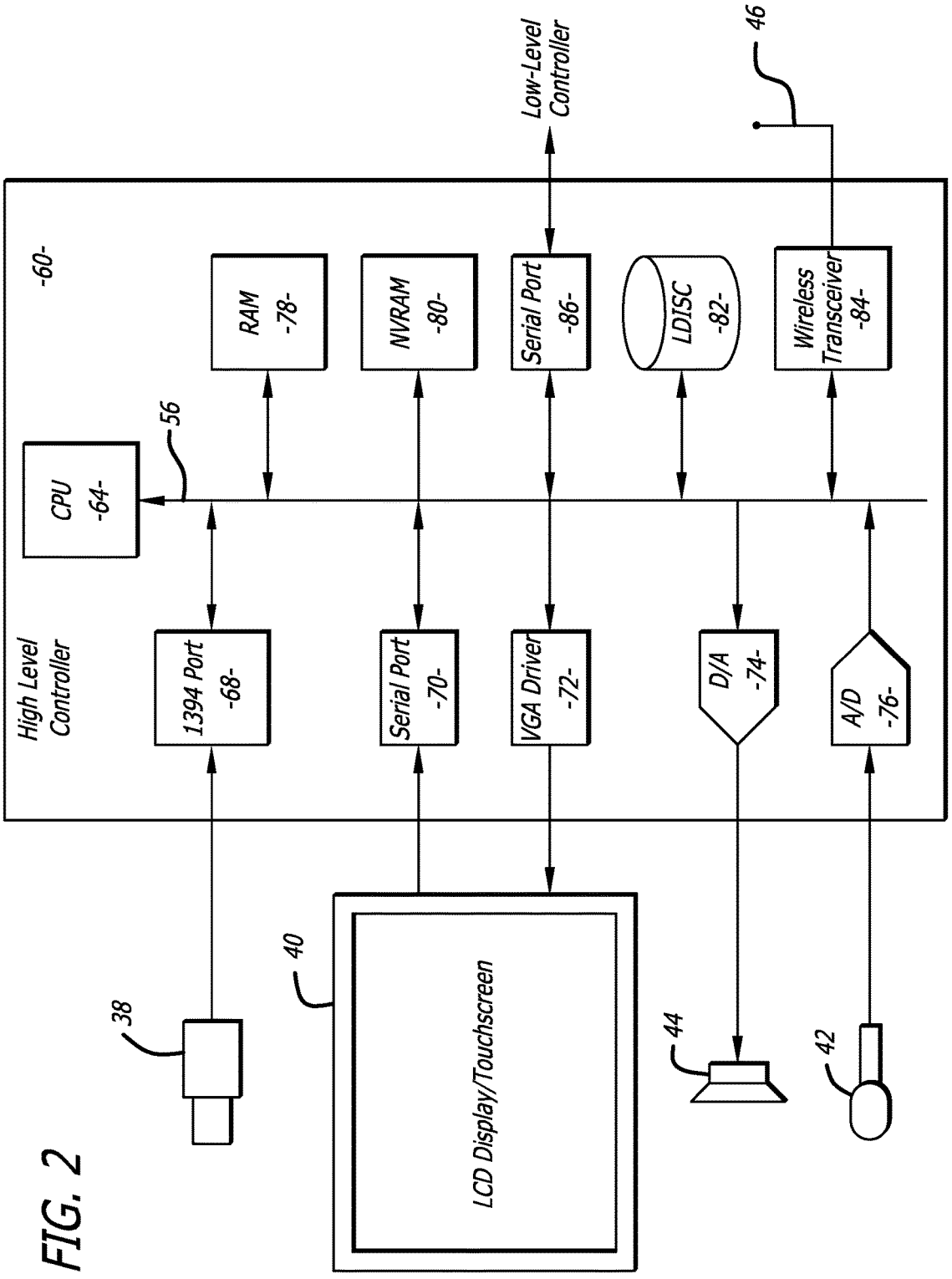
44
36
198

FIG. 1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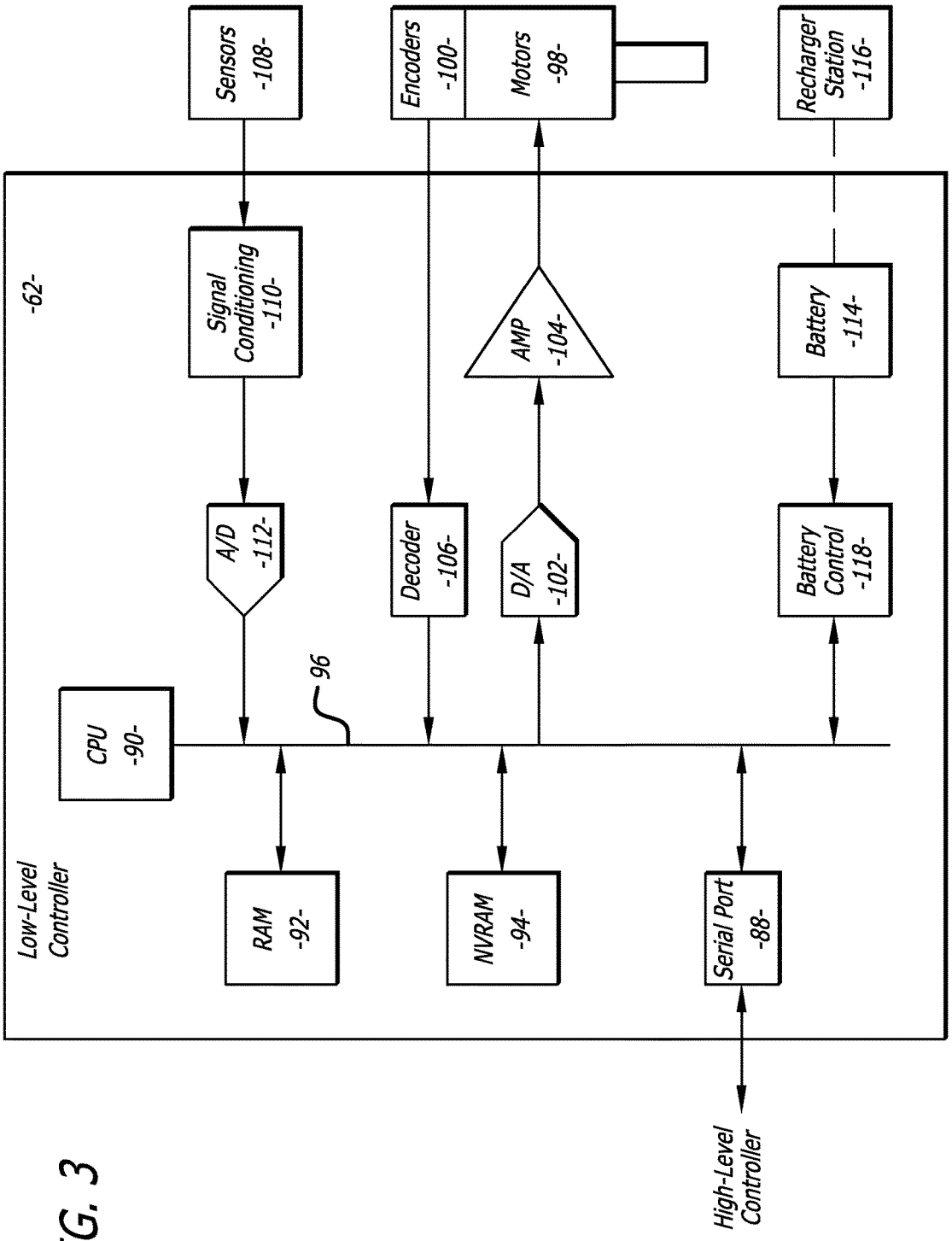
-60-
RAM -78-
NVRAM -80-
Serial Port -86-
LDISC -82-
Wireless Transceiver -84-
56
CPU -64-
High Level Controller
1394 Port -68-
Serial Port -70-
VGA Driver -72-
D/A -74-
A/D -76-
38
40
LCD Display/Touchscreen
44
42

FIG. 2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Decoder -106-
D/A -102-
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CPU -90-
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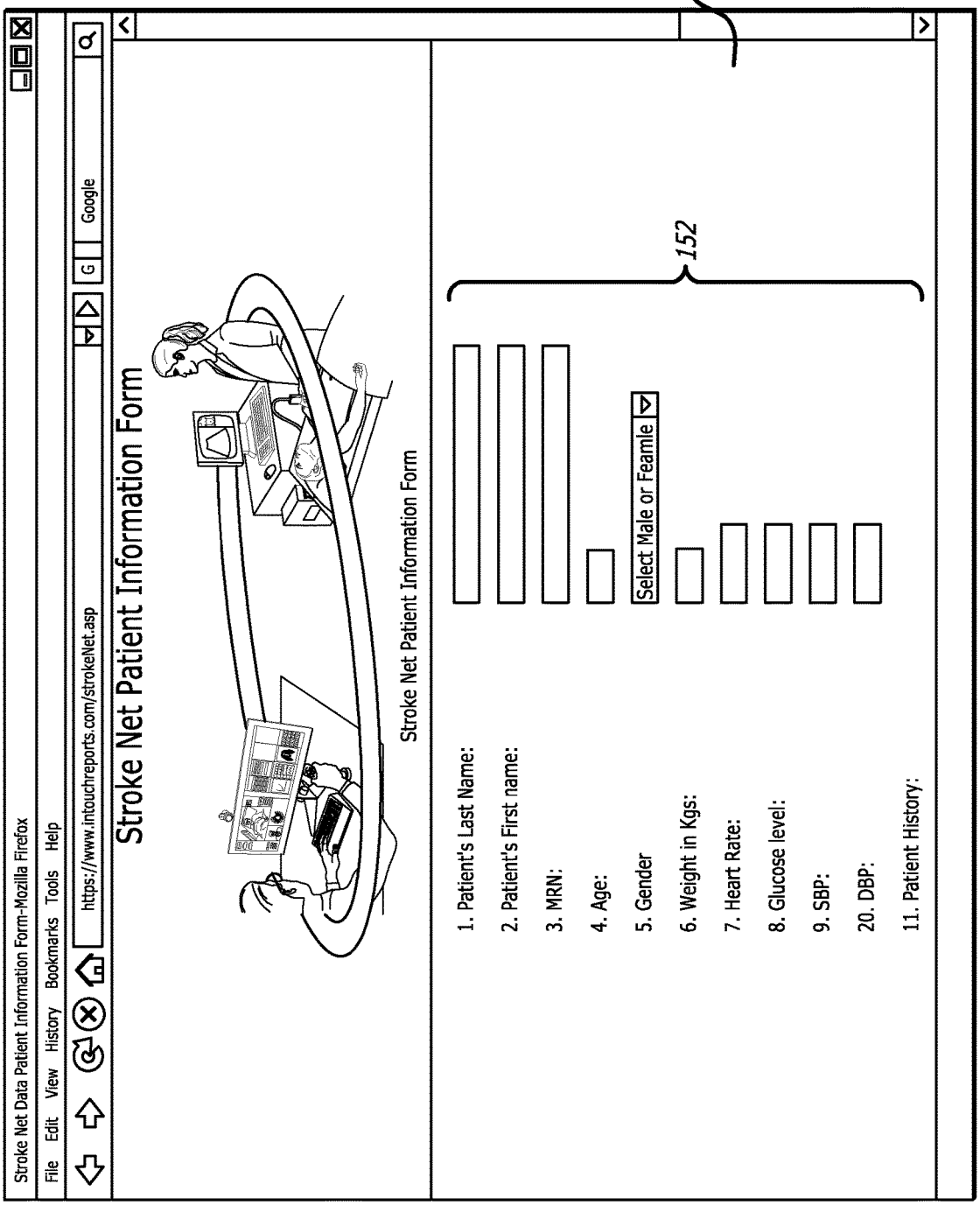
RAM -92-
NVRAM -94-
Serial Port -88-
High-Level Controller

FIG. 3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https://www.intouchreports.com/strokeNet.asp
Google
Stroke Net Patient Information Form
Stroke Net Patient Information Form
1. Patient's Last Name:
2. Patient's First name:
3. MRN:
4. Age:
5. Gender
Select Male or Feamle
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7. Heart Rate:
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9. SBP:
20. DBP:
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150
152

FIG. 4

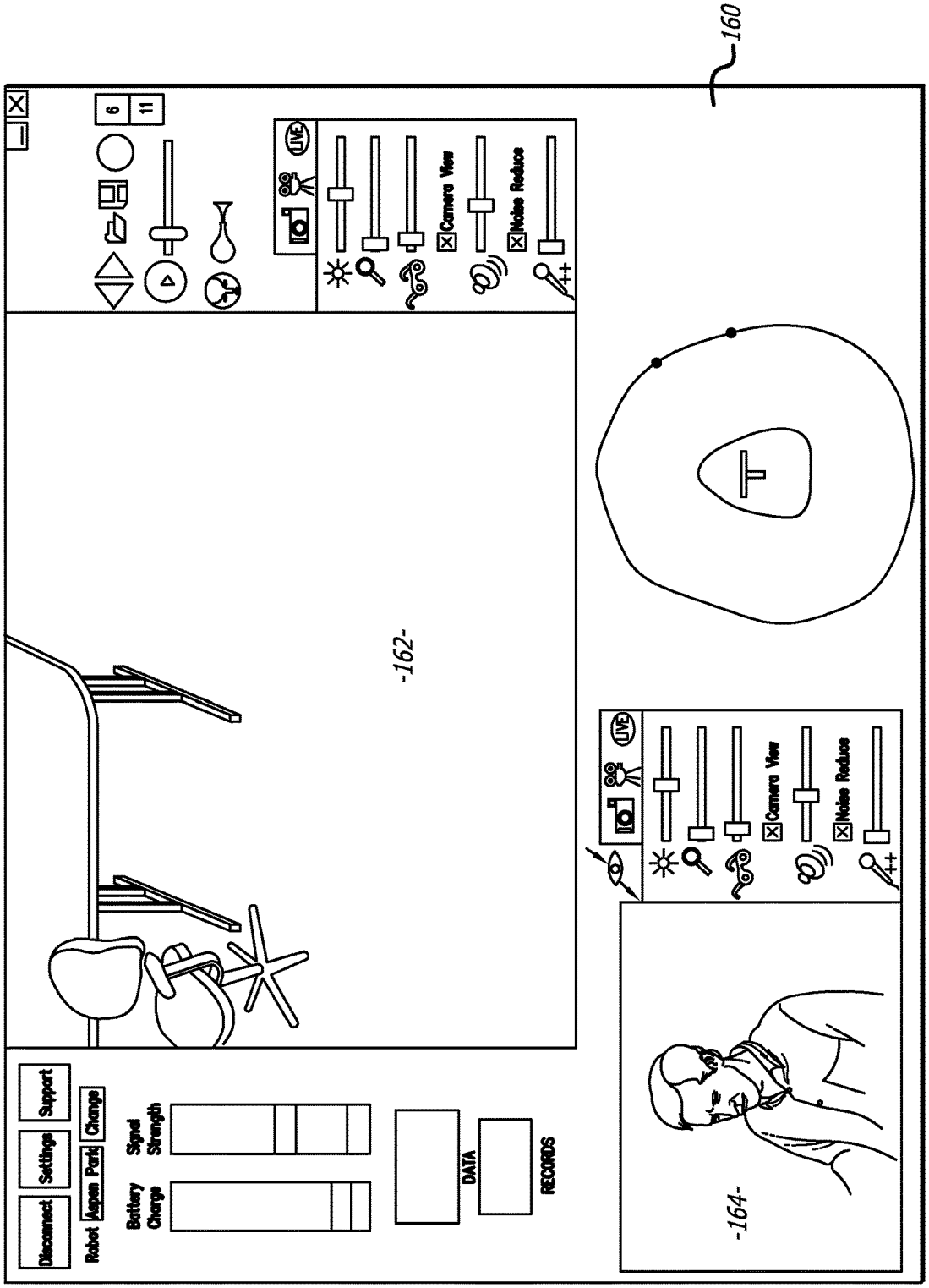

160
-162-
-164-
Camera View
Noise Reduce
LIVE
Disconnect
Robot
Aspen Park
Settings
Support
Change
Signal Strength
Battery Charge
DATA
RECORDS

FIG. 5

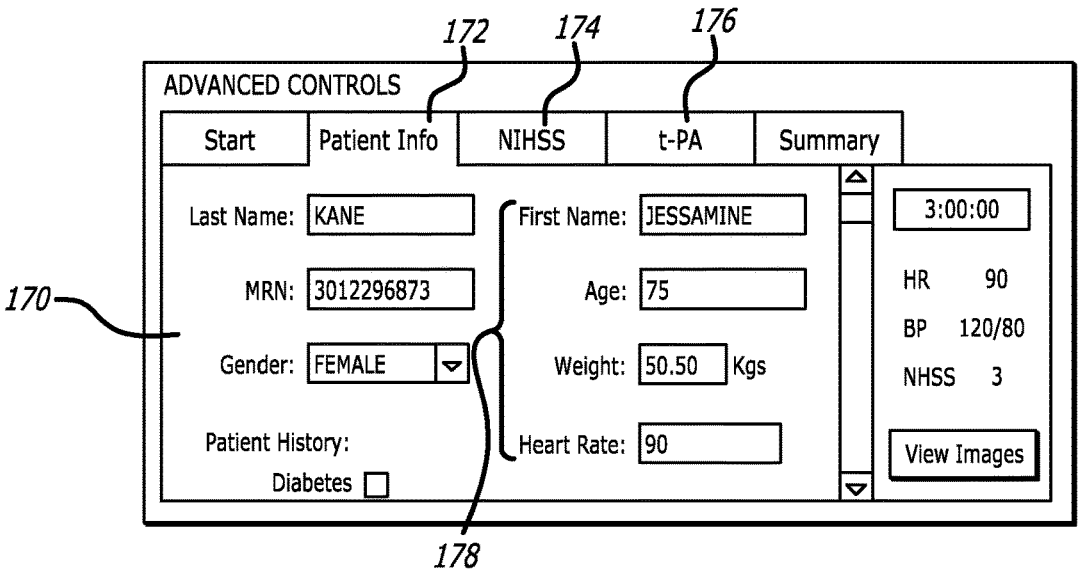
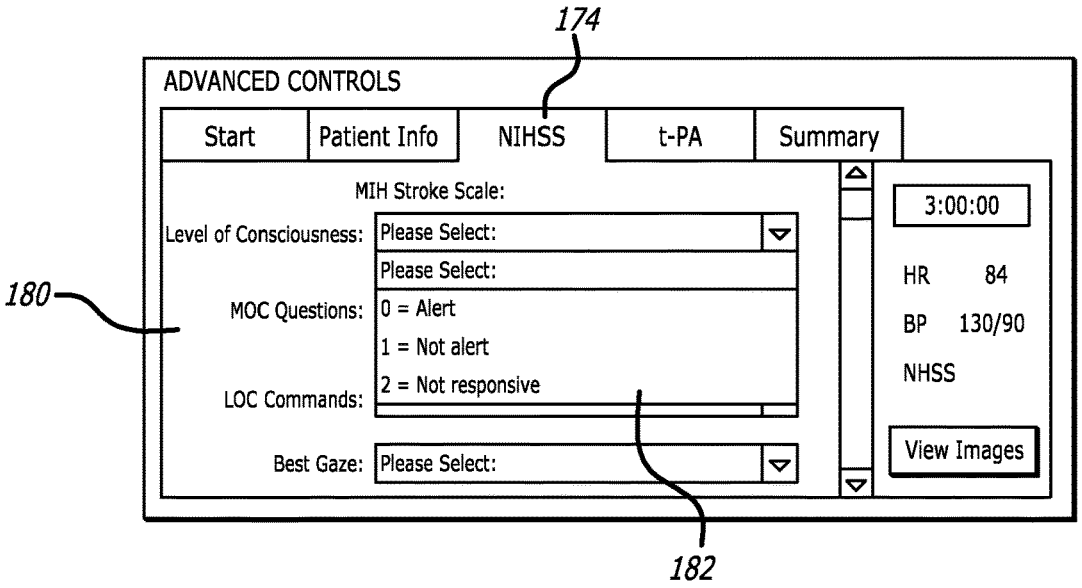

172
174
176
ADVANCED CONTROLS
Start
Patient Info
NIHSS
t-PA
Summary
Last Name: KANE
First Name: JESSAMINE
MRN: 3012296873
Age: 75
Gender: FEMALE
Weight: 50.50 Kgs
Patient History:
Diabetes
Heart Rate: 90
3:00:00
HR 90
BP 120/80
NHSS 3
View Images
170
178

FIG. 6


174
ADVANCED CONTROLS
Start
Patient Info
NIHSS
t-PA
Summary
MIH Stroke Scale:
Level of Consciousness: Please Select:
Please Select:
MOC Questions:
0 = Alert
1 = Not alert
2 = Not responsive
LOC Commands:
Best Gaze: Please Select:
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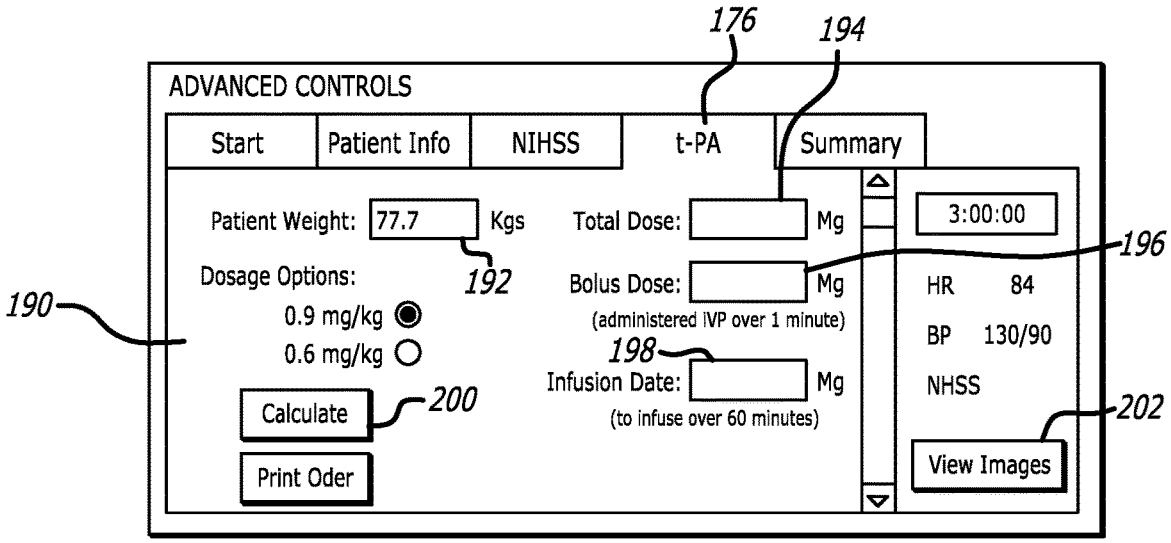
HR 84
BP 130/90
NHSS
View Images
180
182

FIG. 7


176
194
ADVANCED CONTROLS
Start
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NIHSS
t-PA
Summary
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77.7
Kgs
192
Total Dose:
Mg
3:00:00
196
Dosage Options:
190
Bolus Dose:
Mg
HR 84
0.9 mg/kg
(administered IVP over 1 minute)
0.6 mg/kg
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NHSS
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(to infuse over 60 minutes)
202
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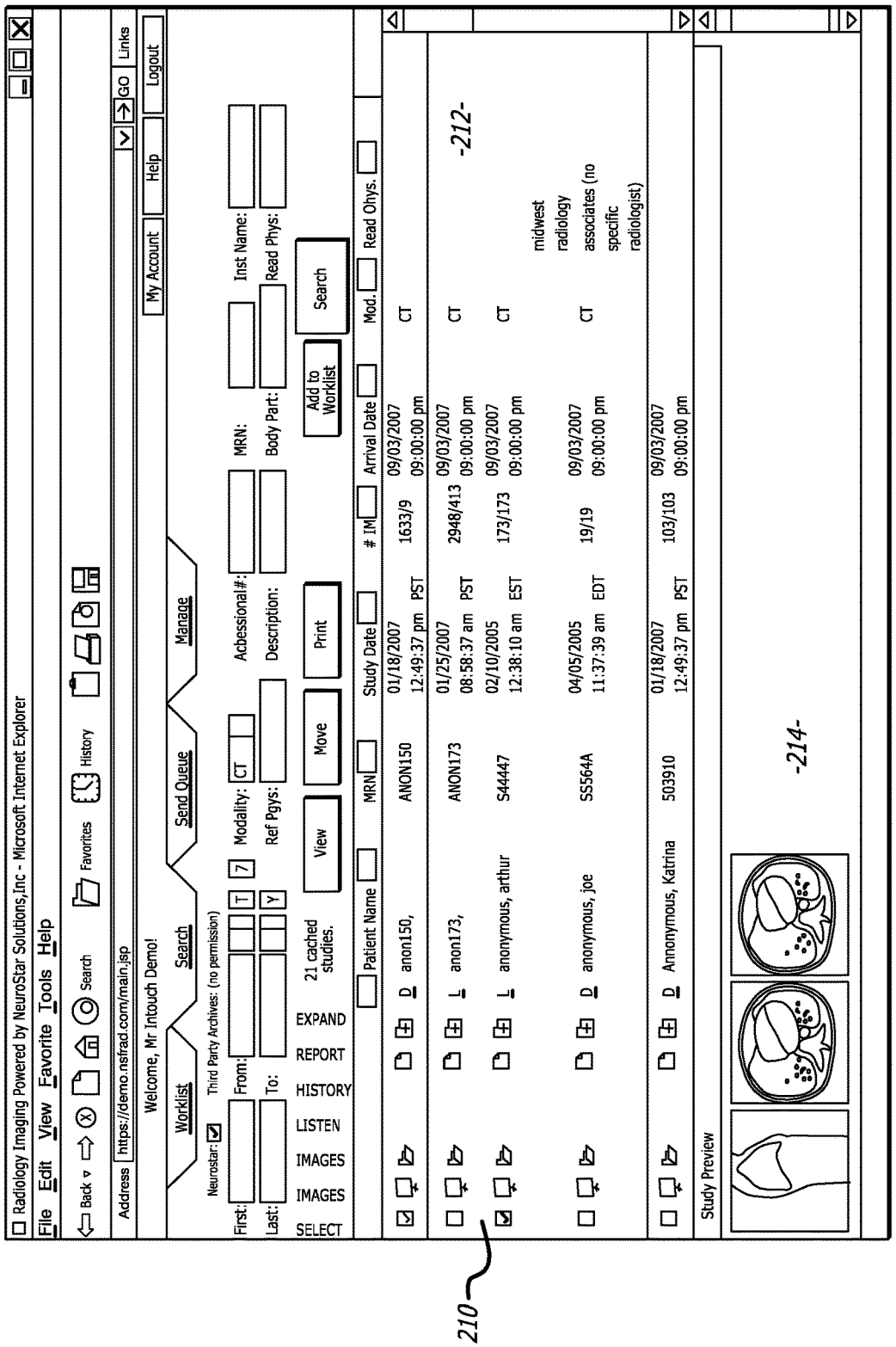
View Images

FIG. 8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Welcome, Mr Intouch Demo!
My Account Help Logout
Worklist Search Send Queue Manage
Neurostar: Third Party Archives: (no permission)
First: From: Modality: CT Acbessional#: MRN: Inst Name:
Last: To: Ref Pgys: Description: Body Part: Read Phys:
21 cached studies.
View Move Print Add to Worklist Search
EXPAND
REPORT
HISTORY
LISTEN
IMAGES
IMAGES
SELECT
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Annonymous, Katrina 503910 01/18/2007 12:49:37 pm PST 103/103 09/03/2007 09:00:00 pm
Study Preview
210
212
214

FIG. 9

ROBOTIC BASED HEALTH CARE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation of U.S. application Ser. No. 12/082,953 filed Apr. 14, 2008 now U.S. Pat. No. 8,179,418.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the fields of health care and robotics.

2. Background Information

The increasing complexity of healthcare and resulting clinical specialization is causing fragmentation of care compromising patient safety and hospital efficiency. There is the need for availability of clinical specialist expertise to cut across time and space as well as the need for standardization and dissemination of best practices and protocols for optimal quality of care for citizens regardless of where they live.

The need for clinical specialist expertise is especially acute in the diagnosis, and treatment of stroke whereby immediate access to expertise and interdisciplinary communication and collaboration is key. Stroke is the second cause of death worldwide and the third leading cause of death in the United States. Recent development of several new therapies including tPA and neuro-endovascular procedures such as coiling offers real hope to change the once bleak prognosis for stroke victims. However, these new therapies are not widely available. Nationally, fewer than 5% of stroke victims are receiving any sort of treatment compared with leading stroke centers where approximately 25% of victims are treated. Most community hospitals do not have the basic patient assessment capability in place on a 24/7 basis nor have they established the appropriate ED treatment protocols. Additionally, only a very few hospitals have the specialists on staff required for neuro-endovascular procedures. Therefore stroke patients are either immediately transferred without proper evaluation or go untreated.

A major challenge in delivering stroke care relates to the time elements of stroke. The adage "time is brain" is often heard. The challenge is to get the right expertise and treatment to the patient at the right time. This encompasses the entire continuum of care from emergency medical services and ambulance transport to evaluation in the ED and definitive treatment. Some stroke care guidelines have been established by the National Institute for Neurological Disorders and Stroke (NINDS). For example, the guidelines suggest getting a patient with symptoms of stroke to stroke expertise (e.g. neurologist, stroke team activation) within fifteen minutes. The use of the word "expertise" here is significant in that the expert need not be physically present next to the patient but could be made available through a consult, for example, over the phone.

BRIEF SUMMARY OF THE INVENTION

A robotic system that includes a mobile robot that has a camera. The system also includes a user interface that allows medical information to be entered by a user. The mobile robot is coupled to a remote station that can control movement of the robot. The remote station includes a monitor that is coupled to the mobile robot camera and displays the medical information.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a robotic system;

FIG. **2** is a schematic of an electrical system of a robot;

FIG. **3** is a further schematic of the electrical system of the robot;

FIG. **4** is a graphical user interface of a user interface;

FIG. **5** is a graphical user interface at a remote station;

FIG. **6** is a graphical user interface at the remote station;

FIG. **7** is a graphical user interface when a NIHSS tab is selected;

FIG. **8** is a graphical user interface displayed when a t-PA table is selected

FIG. **9** is a graphical user interface displayed when a view images button is selected.

DETAILED DESCRIPTION

Disclosed is a robotic system that can be used to treat a patient. The robotic system includes a mobile robot that has a camera. The mobile robot is controlled by a remote station that has a monitor. A physician can use the remote station to move the mobile robot into view of a patient. An image of the patient is transmitted from the robot camera to the remote station monitor. A medical personnel at the robot site can enter patient information into the system through a user interface. The patient information can stored in a server. The physician can access the information from the remote station. The remote station may provide graphical user interfaces that display the patient information and provide a medical tool. By way of example, the remote station may present to the user a NIHSS questionnaire to determine the severity of a stroke. The graphical user interfaces may include an interface that provides a patient management plan such as a calculated dosage. The medical tool and dosage can be transmitted to the user interface so that this information can be viewed by medical personnel in physical proximity to the patient. The system allows a clinical specialist to remotely observe and treat a patient. This is particularly advantageous when treating stroke patients, where time is critical.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a robotic system **10**. The robotic system **10** includes one or more robots **12**. Each robot **12** has a base station **14**. The robot **12** is coupled to a remote control station **16**. The remote control station **16** may be coupled to the base station **14** through a network **18**. By way of example, the network **18** may be either a packet switched network such as the Internet, or a circuit switched network such has a Public Switched Telephone Network (PSTN) or other broadband system. The base station **14** may be coupled to the network **18** by a modem **20** or other broadband network interface device. By way of example, the base station **14** may be a wireless router. Alternatively, the robot **12** may have a direct connection to the network thru for example a satellite.

The remote control station **16** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **16** is typically located in a place that is remote from the robot **12**. Although only one remote control station **16** is shown, the system **10** may include a plurality of remote stations. In general any number of robots **12** may be controlled by any number of remote stations **16** or other robots **12**. For example, one remote station **16** may be coupled to a plurality of robots **12**, or one robot **12** may be coupled to a plurality of remote stations **16**, or a plurality of robots **12**.

Each robot **12** includes a movement platform **34** that is attached to a robot housing **36**. The robot **12** may also have a camera **38**, a monitor **40**, a microphone(s) **42** and a

speaker(s) **44**. The microphone **42** and speaker **30** may create a stereophonic sound. The robot **12** may also have an antenna **46** that is wirelessly coupled to an antenna **48** of the base station **14**. The system **10** allows a user at the remote control station **16** to move the robot **12** through operation of the input device **32**. The robot camera **38** is coupled to the remote monitor **24** so that a user at the remote station **16** can view a patient. Likewise, the robot monitor **40** is coupled to the remote camera **26** so that the patient can view the user. The microphones **28** and **42**, and speakers **30** and **44**, allow for audible communication between the patient and the user.

The remote station computer **22** may operate Microsoft OS software and WINDOWS XP or other operating systems such as LINUX. The remote computer **22** may also operate a video driver, a camera driver, an audio driver and a joystick driver. The video images may be transmitted and received with compression software such as MPEG CODEC.

The system **10** may include a records server **50** that can be accessed through the network **18**. Patient information can be provided to the server **50** through a user interface **52**. The user interface **52** may or may not be in close proximity to the robot **12**. For example, the user interface may be a computer located at a nurses station where information is entered when a patient checks into a facility. The robot **12** can be moved into view of the patient so that patient information can be entered into the system while a physician is viewing the patient through the robot camera. The physician can remotely move the robot to obtain different viewing angles of the patient. The user interface **52** may be a separate computer terminal. Alternatively, the user interface **52** may be integral with the robot. For example, the robot monitor may be a touch screen that allows a user to enter data into the system through the robot **12**. The server **50** may contain other medical records of a patient such as written records of treatment, patient history, medication information, x-rays, EKGs, laboratory results, physician notes, etc.

The system **10** may also include an image server **54** and a registry server **56**. The image server **54** may include medical images. For example, the medical images may include CT scans of a patient's brain. The images can be downloaded to one of the remote stations **14** through the network **18**. The registry server **56** may store historical data on patients. The historical data can be downloaded to a remote computer **16** through the network **18**.

FIGS. **2** and **3** show an embodiment of a robot **12**. Each robot **12** may include a high level control system **60** and a low level control system **62**. The high level control system **60** may include a processor **64** that is connected to a bus **66**. The bus is coupled to the camera **38** by an input/output (I/O) port **68**, and to the monitor **40** by a serial output port **70** and a VGA driver **72**. The monitor **40** may include a touchscreen function that allows a user to enter input by touching the monitor screen.

The speaker **44** is coupled to the bus **56** by a digital to analog converter **74**. The microphone **42** is coupled to the bus **66** by an analog to digital converter **76**. The high level controller **60** may also contain random access memory (RAM) device **78**, a non-volatile RAM device **80** and a mass storage device **82** that are all coupled to the bus **72**. The mass storage device **82** may contain medical files of the patient that can be accessed by the user at the remote control station **16**. For example, the mass storage device **82** may contain a picture of the patient. The user, particularly a health care provider, can recall the old picture and make a side by side comparison on the monitor **24** with a present video image of the patient provided by the camera **38**. The robot antennae **46** may be coupled to a wireless transceiver **84**. By way of example, the transceiver **84** may transmit and receive information in accordance with IEEE 802.11b.

The controller **64** may operate with a LINUX OS operating system. The controller **64** may also operate MS WINDOWS along with video, camera and audio drivers for communication with the remote control station **16**. Video information may be transceived using MPEG CODEC compression techniques. The software may allow the user to send e-mail to the patient and vice versa, or allow the patient to access the Internet. In general the high level controller **60** operates to control communication between the robot **12** and the remote control station **16**.

The high level controller **60** may be linked to the low level controller **62** by a serial port **88**. The low level controller **62** includes a processor **90** that is coupled to a RAM device **92** and non-volatile RAM device **94** by a bus **96**. Each robot **12** contains a plurality of motors **98** and motor encoders **100**. The encoders **100** provide feedback information regarding the output of the motors **98**. The motors **98** can be coupled to the bus **96** by a digital to analog converter **102** and a driver amplifier **104**. The encoders **100** can be coupled to the bus **86** by a decoder **106**. Each robot **12** may have a number of proximity sensors **108** (see also FIG. **1**). The sensors **108** can be coupled to the bus **96** by a signal conditioning circuit **110** and an analog to digital converter **112**.

The low level controller **62** runs software routines that mechanically actuate the robot **12**. For example, the low level controller **62** provides instructions to actuate the movement platform to move the robot **12**. The low level controller **62** may receive movement instructions from the high level controller **60**. The movement instructions may be received as movement commands from the remote control station or another robot. Although two controllers are shown, it is to be understood that each robot **12** may have one controller, or more than two controllers, controlling the high and low level functions.

The various electrical devices of each robot **12** may be powered by a battery(ies) **114**. The battery **114** may be recharged by a battery recharger station **116** (see also FIG. **1**). The low level controller **62** may include a battery control circuit **118** that senses the power level of the battery **114**. The low level controller **62** can sense when the power falls below a threshold and then send a message to the high level controller **60**.

The system may be the same or similar to a robotic system provided by the assignee InTouch Technology, Inc. of Santa Barbara, Calif. under the name RP-7, which is hereby incorporated by reference. The system may also be the same or similar to the system disclosed in U.S. Pat. No. 7,292,912, which is hereby incorporated by reference.

FIG. **4** shows a graphical user interface **150** provided at the user interface **52**. The graphical user interface **150** includes a plurality of data fields **152** that can be filled by the user. The data fields **152** can request patient information such as name, age, etc. The data fields may also include request for medical data such as heart rate, glucose level and blood pressure ("SBP" and "DBP").

FIG. **5** shows a display user interface ("DUI") **160** that can be displayed at the remote station **14**. The DUI **160** may include a robot view field **162** that displays a video image captured by the camera of the robot. The DUI **160** may also include a station view field **164** that displays a video image provided by the camera of the remote station **14**. The DUI **160** may be part of an application program stored and operated by the computer **22** of the remote station **14**.

FIG. **6** shows a graphical user interface **170** that is displayed by the monitor of the remote station **16**. The interface **170** includes a "PATIENT INFO" tab **172**, a "NIHSS" tab **174** and a "t-PA" tab **176**. Selection of the PATIENT INFO tab **172** displays various data fields **178** including patient name, age, weight, heart rate, etc. This may be the same information through the user interface.

FIG. **7** shows an interface **180** when the "NIHSS" tab **174** is selected. The interface **180** has a data field **182** that provides a questionnaire to rate the severity of a stroke victim using the NIHSS stroke scale. This provides a readily available medical tool for the physician.

FIG. **8** shows an interface **190** when the "t-PA" tab **176** is selected. The interface **190** may include a data field **192** that provides the patient's weight, a "TOTAL DOSE" data field **194**, a "BOLUS DOSE" data field **196** and an "INFUSION DOSE" data field **198**. The interface **190** may also include a "CALCULATE" button **200**. When the CALCULATE button **182** is selected the data fields **194**, **196** and **198** are automatically populated with a calculated dosage. This provides a patient management plan for the physician to review. The interfaces **170**, **180** and **190** also have a "VIEW IMAGES" button **202** that when selected displays an interface **210** shown in FIG. **9**. The interface **210** includes a data field **212** and an image field **214**. The image field **214** can provide a plurality of medical images such as a CT scan of the patient's head.

The system is useful for allowing a physician to remotely view and treat a stroke patient. The system provides patient information, NIHSS stroke severity assessment, calculated t-PA dosage and CT head images that allow the physician to provide real time remote patient treatment.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific construction's and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A robotic system, comprising:

a network;

a robot in the vicinity of a patient and coupled to the network, the robot having a robot camera, a robot monitor, a robot microphone, and a robot speaker, the robot camera captures an image of the patient;

a computer at a nurses station that displays a user interface, the user interface allows medical information to be entered by displaying a plurality of data fields that include at least one patient information field and at least one medical data field that are filled by a user at the computer, said computer is separate from said robot and is coupled to the network independently of the robot; and,

a remote station located remotely from both the robot and the computer at the nurses station, the remote station is coupled to said robot via the network and controls said robot, said remote station includes a monitor that displays both the image of the patient and said patient information and said medical data provided by the user at the computer at the nurses station.

2. The system of claim **1**, further comprising a records server that is coupled to said remote station and said user interface and stores said medical information.

3. The system of claim **1**, further comprising an image server that is coupled to said remote station and stores a plurality of medical images.

4. The system of claim **2**, wherein said medical information includes patient statistics.

5. The system of claim **1**, wherein said remote station provides a medical tool.

6. The system of claim **1**, wherein said remote station provides a graphical user interface that can receive information and display a patient management plan.

7. The system of claim **6**, wherein said medical tool is a stroke evaluation.

* * * * *

Exhibit C

US008179418B2

(12) **United States Patent**
Wright et al.

(10) **Patent No.: US 8,179,418 B2**
(45) **Date of Patent: *May 15, 2012**

(54) **ROBOTIC BASED HEALTH CARE SYSTEM**

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This patent is subject to a terminal disclaimer.

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G05B 15/00 (2006.01)
G06F 19/00 (2011.01)

(52) **U.S. Cl.** **348/14.05**; 283/54; 283/115; 318/567; 318/568.11; 434/262; 600/300; 700/245; 700/258; 700/259; 700/264; 705/2; 705/3; 715/719

(58) **Field of Classification Search** 318/567, 318/568.11; 348/14.05; 600/300; 700/245, 700/258, 259, 264; 901/1; 283/54, 115; 434/262; 705/2, 3; 715/719
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,413,693	A	11/1983	Derby
4,638,445	A	1/1987	Mattaboni
4,709,265	A	11/1987	Silverman et al.
4,803,625	A	2/1989	Fu et al.
4,875,172	A	10/1989	Kanayama
4,977,971	A	12/1990	Crane, III et al.
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,130,794	A	7/1992	Ritchey
5,341,242	A	8/1994	Gilboa et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2289697 A1 11/1998

(Continued)

OTHER PUBLICATIONS

International Preliminary report on Patentability received for PCT Application No. PCT/US2009/036541, mailed on Oct. 28, 2010, 6 pages.

(Continued)

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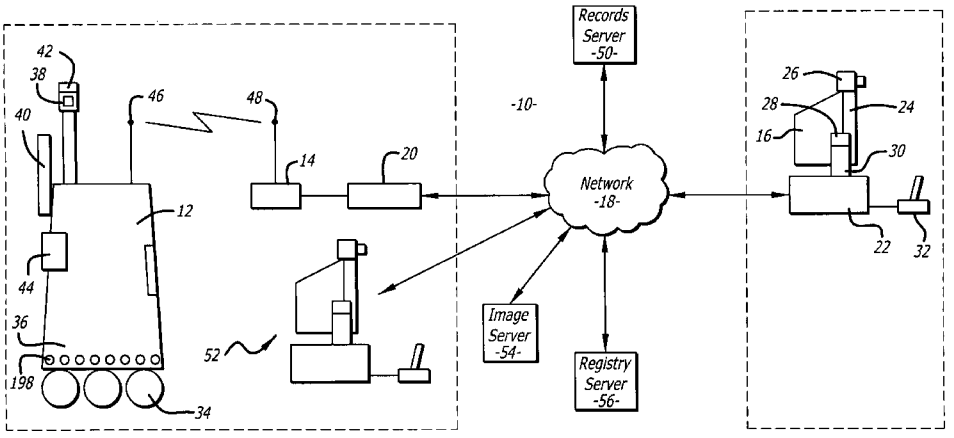
(57) **ABSTRACT**

A robotic system that can be used to treat a patient. The robotic system includes a mobile robot that has a camera. The mobile robot is controlled by a remote station that has a monitor. A physician can use the remote station to move the mobile robot into view of a patient. An image of the patient is transmitted from the robot camera to the remote station monitor. A medical personnel at the robot site can enter patient information into the system through a user interface. The patient information can be stored in a server. The physician can access the information from the remote station. The remote station may provide graphical user interfaces that display the patient information and provide both a medical tool and a patient management plan.

24 Claims, 8 Drawing Sheets



U.S. PATENT DOCUMENTS

5,374,879	A		12/1994	Pin et al.
5,441,047	A		8/1995	David et al.
5,442,728	A		8/1995	Kaufman et al.
5,462,051	A		10/1995	Oka et al.
5,544,649	A		8/1996	David et al.
5,553,609	A		9/1996	Chen et al.
5,572,229	A		11/1996	Fisher
5,652,849	A	*	7/1997	Conway et al. 715/719
5,762,458	A		6/1998	Wang et al.
5,786,846	A		7/1998	Hiroaki
5,802,494	A		9/1998	Kuno
5,917,958	A		6/1999	Nunally et al.
927,423	A		7/1999	Wada et al.
5,959,423	A		9/1999	Nakanishi et al.
5,966,130	A		10/1999	Benman, Jr.
6,133,944	A		10/2000	Braun et al.
6,135,228	A		10/2000	Asada et al.
6,211,903	B1		4/2001	Bullister
6,219,587	B1		4/2001	Ahlin et al.
6,232,735	B1	*	5/2001	Baba et al. 318/567
6,233,504	B1		5/2001	Das et al.
6,256,556	B1	*	7/2001	Zenke 700/245
6,259,806	B1		7/2001	Green
6,292,713	B1	*	9/2001	Jouppi et al. 700/245
6,304,050	B1	*	10/2001	Skaar et al. 318/568.11
6,321,137	B1		11/2001	De Smet
6,325,756	B1		12/2001	Webb et al.
6,330,493	B1		12/2001	Takahashi et al.
6,346,950	B1		2/2002	Jouppi
6,369,847	B1		4/2002	James et al.
6,430,471	B1	*	8/2002	Kintou et al. 700/245
6,430,475	B2		8/2002	Okamoto et al.
6,438,457	B1		8/2002	Yokoo et al.
6,463,361	B1		10/2002	Wang et al.
6,466,844	B1		10/2002	Ikeda et al.
6,491,701	B2		12/2002	Tierney et al.
6,496,099	B2		12/2002	Wang et al.
6,507,773	B2	*	1/2003	Parker et al. 700/258
6,522,906	B1		2/2003	Salisbury et al.
6,532,404	B2		3/2003	Colens
6,535,182	B2		3/2003	Stanton
6,535,793	B2	*	3/2003	Allard 700/259
6,540,039	B1		4/2003	Yu et al.
6,543,899	B2		4/2003	Covannon et al.
6,549,215	B2		4/2003	Jouppi
6,604,019	B2		8/2003	Ahlin et al.
6,646,677	B2		11/2003	Noro et al.
6,684,129	B2		1/2004	Salisbury et al.
6,691,000	B2		2/2004	Nagai et al.
6,728,599	B2		4/2004	Wang et al.
6,781,606	B2		8/2004	Jouppi
6,784,916	B2		8/2004	Smith
6,799,065	B1		9/2004	Niemeyer
6,799,088	B2		9/2004	Wang et al.
6,804,656	B1		10/2004	Rosenfeld et al.
6,836,703	B2		12/2004	Wang et al.
6,839,612	B2		1/2005	Sanchez et al.
6,840,904	B2		1/2005	Goldberg
6,845,297	B2		1/2005	Allard
6,852,107	B2		2/2005	Wang et al.
6,871,117	B2		3/2005	Wang et al.
6,879,879	B2		4/2005	Jouppi et al.
6,892,112	B2		5/2005	Wang et al.
6,895,305	B2		5/2005	Lathan et al.
6,914,622	B1		7/2005	Smith et al.
6,925,357	B2		8/2005	Wang et al.
6,995,664	B1		2/2006	Darling
7,115,102	B2		10/2006	Abbruscato
7,123,285	B2		10/2006	Smith et al.
7,129,970	B2		10/2006	James et al.
7,151,982	B2		12/2006	Liff et al.
7,154,526	B2		12/2006	Foote et al.
7,155,306	B2		12/2006	Haitin et al.
7,156,809	B2		1/2007	Quy
7,161,322	B2		1/2007	Wang et al.
7,164,969	B2	*	1/2007	Wang et al. 700/245
7,174,238	B1		2/2007	Zweig
7,184,559	B2		2/2007	Jouppi
7,188,000	B2		3/2007	Chiappetta et al.
7,256,708	B2		8/2007	Rosenfeld
7,262,573	B2		8/2007	Wang et al.
7,289,883	B2	*	10/2007	Wang et al. 700/245
7,593,030	B2	*	9/2009	Wang et al. 348/14.05
7,761,185	B2	*	7/2010	Wang et al. 700/259
8,116,910	B2	*	2/2012	Walters et al. 700/259
2001/0010053	A1		7/2001	Ben-Shachar et al.
2001/0037163	A1		11/2001	Allard
2001/0054071	A1		12/2001	Loeb
2002/0027597	A1		3/2002	Sachau
2002/0057279	A1		5/2002	Jouppi
2002/0058929	A1		5/2002	Green
2002/0063726	A1		5/2002	Jouppi
2002/0120362	A1		8/2002	Lathan et al.
2002/0130950	A1		9/2002	James et al.
2002/0141595	A1		10/2002	Jouppi
2002/0183894	A1		12/2002	Wang et al.
2003/0048481	A1		3/2003	Kobayashi
2003/0050733	A1		3/2003	Wang et al.
2003/0060808	A1		3/2003	Wilk
2003/0100892	A1		5/2003	Morley et al.
2003/0114962	A1		6/2003	Niemeyer
2003/0135203	A1		7/2003	Wang et al.
2003/0144579	A1		7/2003	Buss
2003/0144649	A1		7/2003	Ghodoussi et al.
2003/0151658	A1		8/2003	Smith
2003/0199000	A1		10/2003	Valkirs et al.
2003/0220541	A1		11/2003	Salisbury et al.
2004/0019406	A1		1/2004	Wang et al.
2004/0088077	A1		5/2004	Jouppi et al.
2004/0117065	A1		6/2004	Wang et al.
2004/0143421	A1		7/2004	Wang et al.
2004/0162637	A1		8/2004	Wang et al.
2004/0167666	A1		8/2004	Wang et al.
2004/0167668	A1		8/2004	Wang et al.
2004/0174129	A1		9/2004	Wang et al.
2004/0215490	A1		10/2004	Duchon et al.
2005/0021182	A1		1/2005	Wang et al.
2005/0021183	A1		1/2005	Wang et al.
2005/0021187	A1		1/2005	Wang et al.
2005/0024485	A1		2/2005	Castles et al.
2005/0027794	A1		2/2005	Decker
2005/0028221	A1		2/2005	Liu et al.
2005/0035862	A1		2/2005	Wildman et al.
2005/0038416	A1		2/2005	Wang et al.
2005/0038564	A1		2/2005	Burick et al.
2005/0052527	A1		3/2005	Remy et al.
2005/0065438	A1		3/2005	Miller
2005/0065659	A1		3/2005	Tanaka et al.
2005/0110867	A1		5/2005	Schultz
2005/0204438	A1		9/2005	Wang et al.
2006/0007943	A1		1/2006	Fellman
2006/0013263	A1		1/2006	Fellman
2006/0029065	A1		2/2006	Fellman
2006/0047365	A1		3/2006	Ghodoussi et al.
2006/0052676	A1	*	3/2006	Wang et al. 600/300
2006/0064212	A1		3/2006	Thorne
2006/0082642	A1		4/2006	Wang et al.
2006/0098573	A1		5/2006	Beer et al.
2006/0104279	A1		5/2006	Fellman et al.
2006/0142983	A1		6/2006	Sorensen et al.
2006/0173712	A1		8/2006	Joubert
2006/0259193	A1		11/2006	Wang et al.
2007/0064092	A1		3/2007	Sandbeg et al.
2007/0120965	A1		5/2007	Sandberg et al.
2007/0122783	A1	*	5/2007	Habashi 434/262
2007/0192910	A1		8/2007	Vu et al.
2007/0198128	A1		8/2007	Ziegler et al.
2007/0199108	A1		8/2007	Angle et al.
2007/0273751	A1		11/2007	Sachau
2008/0281467	A1	*	11/2008	Pinter 700/245
2009/0055023	A1	*	2/2009	Walters et al. 700/259
2009/0240371	A1	*	9/2009	Wang et al. 700/259
2009/0259339	A1	*	10/2009	Wright et al. 700/264
2010/0191375	A1	*	7/2010	Wright et al. 700/259
2011/0172822	A1	*	7/2011	Ziegler et al. 700/259

FOREIGN PATENT DOCUMENTS

EP	0981905	B1	1/2002
JP	07-257422	A	10/1995
JP	08-084328	A	3/1996
JP	2000-032319	A	1/2000
JP	2002-046088	A	2/2002
JP	2002-305743	A	10/2002

OTHER PUBLICATIONS

F. Ando et al., "A Multimedia Self-service Terminal with Conferencing Functions", 1995, IEEE, pp. 357-362.

Bar-Cohen et al., Virtual reality robotic telesurgery simulations using MEMICA haptic system, Mar. 5, 2001, Internet, pp. 1-7.

Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", Jun. 2003.

Bauer, John et al., "Remote telesurgical mentoring: feasibility and efficacy", 2000, IEEE, pp. 1-9.

Breslow, Michael J., MD et al., "Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcome: An alternative paradigm for intensivist staffing", Critical Care Med, Jan. 2004, vol. 32, No. 1, pp. 31-38.

Brooks, Rodney, Abstracts from Flesh & Machines, How Robots Will Change Us, "Remote Presence", p. 131-147, Feb. 2002.

Celi et al., "The eICU: It's not just telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001.

Cleary et al., "State of the art in surgical robotics: Clinical applications and technology challenges", Feb. 24, 2002 Internet, pp. 1-26.

CNN, Floating 'droids' to roam space corridors of the future, Jan. 12, 2000, Internet, pp. 1-4.

CNN.com/Technology, Paging R.Robot: Machine helps doctors with patients, Sep. 30, 2003, Internet, 1-3.

Davies, "Robotics in Minimally Invasive Surgery", 1995, Internet, pp. 5/1-5/2.

DiGiorgio, James, "Is Your Emergency Department of the 'Leading Edge'?", 2005, Internet, pp. 1-4.

Elhajj et al., "Supermedia in Internet-based telerobotic operations", 2001, Internet, pp. 1-14.

Fetterman, Videoconferencing over the Internet, 2001, Internet, pp. 1-8.

Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation, Apr. 2000, San Francisco, California.

Goldman, Lea, "Machine Dreams", Entrepreneurs, Forbes, May 27, 2002.

Gump, Michael D., "Robot Technology Improves VA Pharmacies", 2001, Internet, pp. 1-3.

Harmo et al., "Moving Eye—Interactive Telepresence Over Internet With a Ball Shaped Mobile Robot", 2000.

Hees, William P., "Communications Design for a Remote Presence Robot", Jan. 14, 2002.

F.A. Candelas Herias et al., "Flexible virtual and remote laboratory for teaching Robotics", FORMATEX 2006, Proc. Advance in Control Education, Madrid, Spain, Jun. 21-23, 2006.

Ishihara, Ken et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Nov. 11-Mar. 5, 1991, IEEE/RSJ, pp. 1145-1150, vol. 2.

Johanson, Supporting video-mediated communication over the Internet, Chalmers University of Technology, Dept of Computer Engineering, Gothenburg, Sweden, 2003.

Jouppi, et al., :Mutually-Immersive Audio Telepresence, Audio Engineering Society Convention Paper, presented at 113th Convention Oct. 2002.

Jouppi, Norman P., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Nov. 16-20, 2002, New Orleans LA.

Kanehiro, Fumio et al., Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting, 2001, IEEE, pp. 3217-3276.

Lim, Hun-ok et al., Control to Realize Human-like Walking of a Biped Humanoid Robot, IEEE 2000, pp. 3271-3276.

Linebarger, John M. et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Presence, Special Issue on Advances in Collaborative VEs (2004).

Loeb, Gerald, "Virtual Visit: Improving Communication for Those Who Need It Most", 2001.

Mack, "Minimally invasive and robotic surgery", 2001, Internet IEEE, pp. 568-572.

Martin, Anya, "Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.

McCardle et al., "The challenge of utilizing new technology in design education", 2000 Internet, pp. 122-127.

"More Online Robots, Robots that Manipulate", Internet, http://ford.ieor.berkeley.edu/ir/robots_a2.html, Feb. 2007.

Nakajima et al., "A Multimedia Teleteaching System sing an Electronic Whiteboard for Two-Way Communication of Motion Videos and Chalkboards", 1993, IEEE, pp. 436-441.

Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2r—Esperimental evaluation . . . ", 2000 IEEE, pp. 175-180.

Ojha, Anad, "An application of Virtual Reality in Rehabilitation", Jan. 1994, IEEE, pp. 4-6.

Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", http://vive.cs.berkeley.edu/capek, 1995.

Paulos, Eric John, "Personal Tele-Embodiment", Fall 2001.

Paulos, et al. , "Ubiquitous Tele-embodiment: Applications and Implications", International Journal of Human Computer Studies, Jun. 1997, vol. 46, No. 6, pp. 861-877.

Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE, vol. 10, No. 4, Aug. 1994.

Robot Hardware Mobile Robotics Research Group, Edinburgh, "Mobile Robotics Research Group", 2000 Internet, pp. 1-2.

Roy et al., "Towards Personal Service Robots for the Elderly", Internet, Mar. 7, 2002.

Salemi et al, "MILO: Personal robot platform", 2005, Internet, pp. 1-6.

Sandt, Frederic et al., "Perceptions for a Transport Robot in Public Environments", 1997, IROS '97.

Shimoga et al., Touch and force reflection for telepresence surgery, 1994, IEEE, pp. 1049-1050.

Stephenson, Gary, "Dr. Robot Tested at Hopkins", Aug. 5, 2003, Internet, pp. 1-2.

Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Dec. 2002, Internet, 1-17.

Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", 1997, IEEE, pp. 2771-2776.

Thrun et al, "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", 2000, Internet pp. 1-35.

Tzafestas, et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", 2000, Internet, pp. 1-23.

Urquhart, Kim, "InTouch's robotic Companion 'beams up' healthcare experts", Medical Device Daily, vol. 7, No. 39, Feb. 27, 2003, p. 1, 4.

Weiss et al., Telework and video-mediated communication: Importance of real-time, interactive communication for workers with disabilities, 1999, Internet, pp. 1-4.

Yamasaki et al., Applying Personal Robots and Active Interface to Video Conference Systems, 1995, Internet, pp. 243-248.

Yong et al., "Robot task execution with telepresence using virtual reality technology", 1998, Internet, pp. 1-9.

Zipperer, Lorri, "Robotic dispensing system", 1999, Internet, pp. 1-2.

Zorn, Benjamin G., "Ubiquitous Telepresence", http://www.cs.colorado.edu/~zorn/ut/vision/vision.htrnl, Mar. 5, 1996.

* cited by examiner

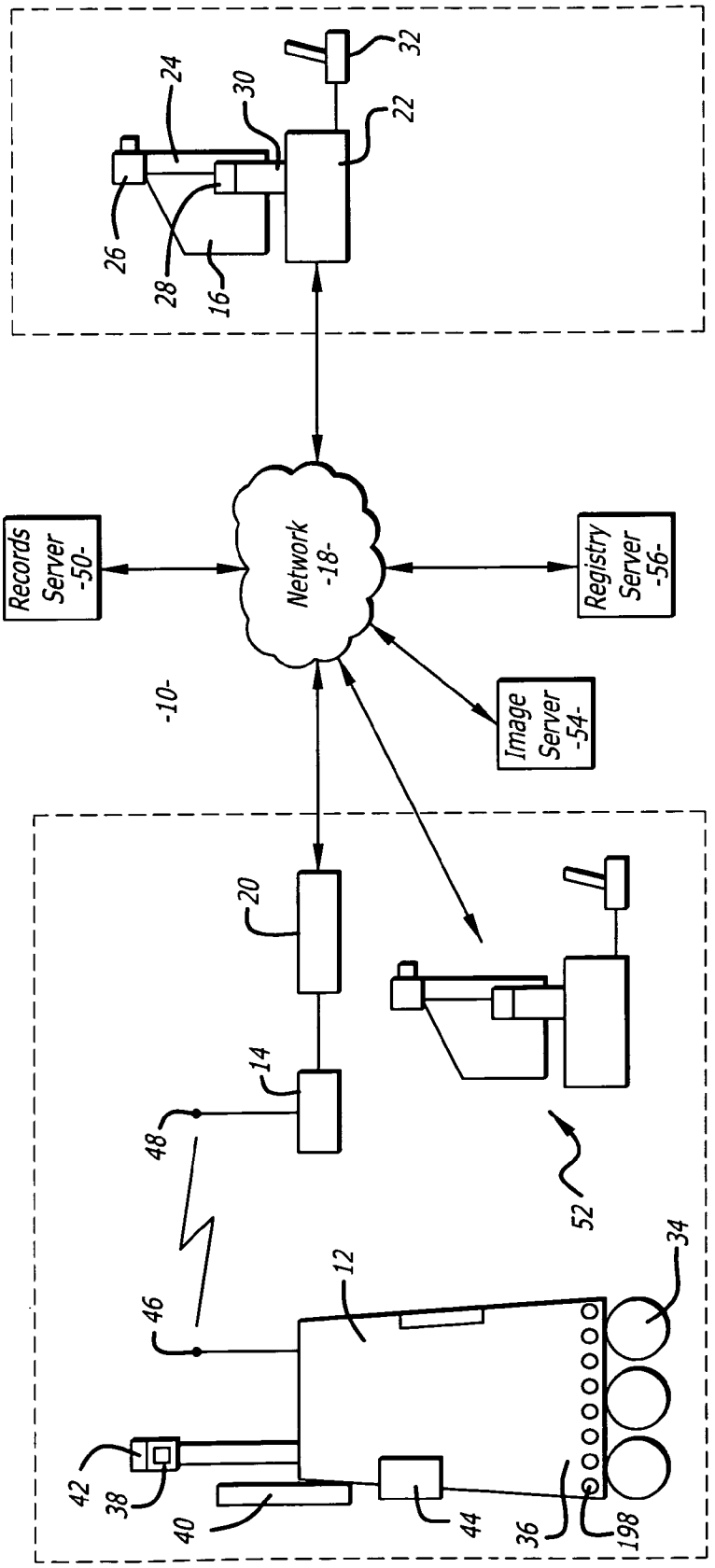

Records Server -50-
Network -18-
Registry Server -56-
Image Server -54-
-10-
24
30
32
22
26
28
16
20
14
48
52
46
12
34
42
38
40
44
36
198

FIG. 1

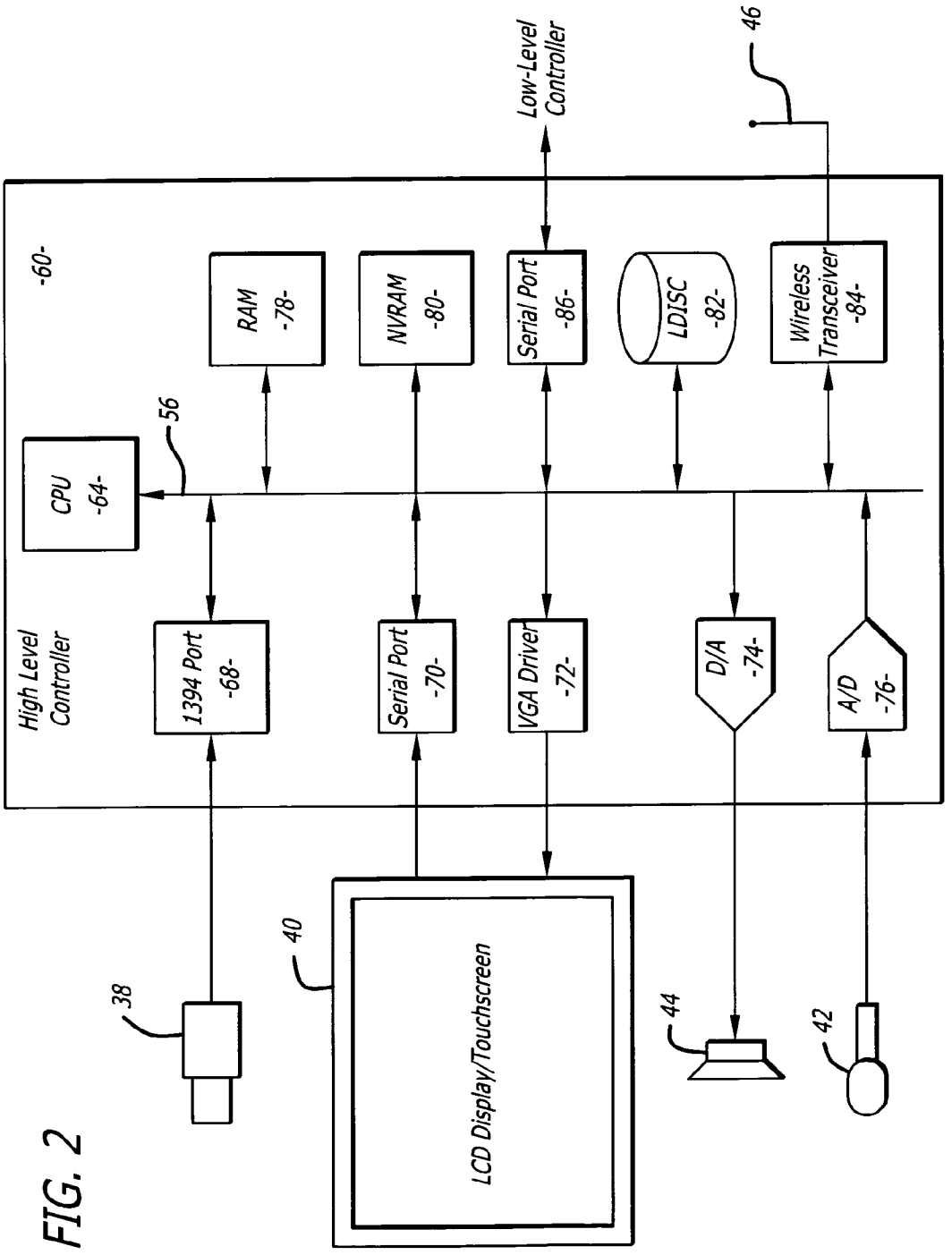

Low-Level Controller
46
-60-
RAM -78-
NVRAM -80-
Serial Port -86-
LDISC -82-
Wireless Transceiver -84-
56
CPU -64-
High Level Controller
1394 Port -68-
Serial Port -70-
VGA Driver -72-
D/A -74-
A/D -76-
38
40
LCD Display/Touchscreen
44
42

FIG. 2

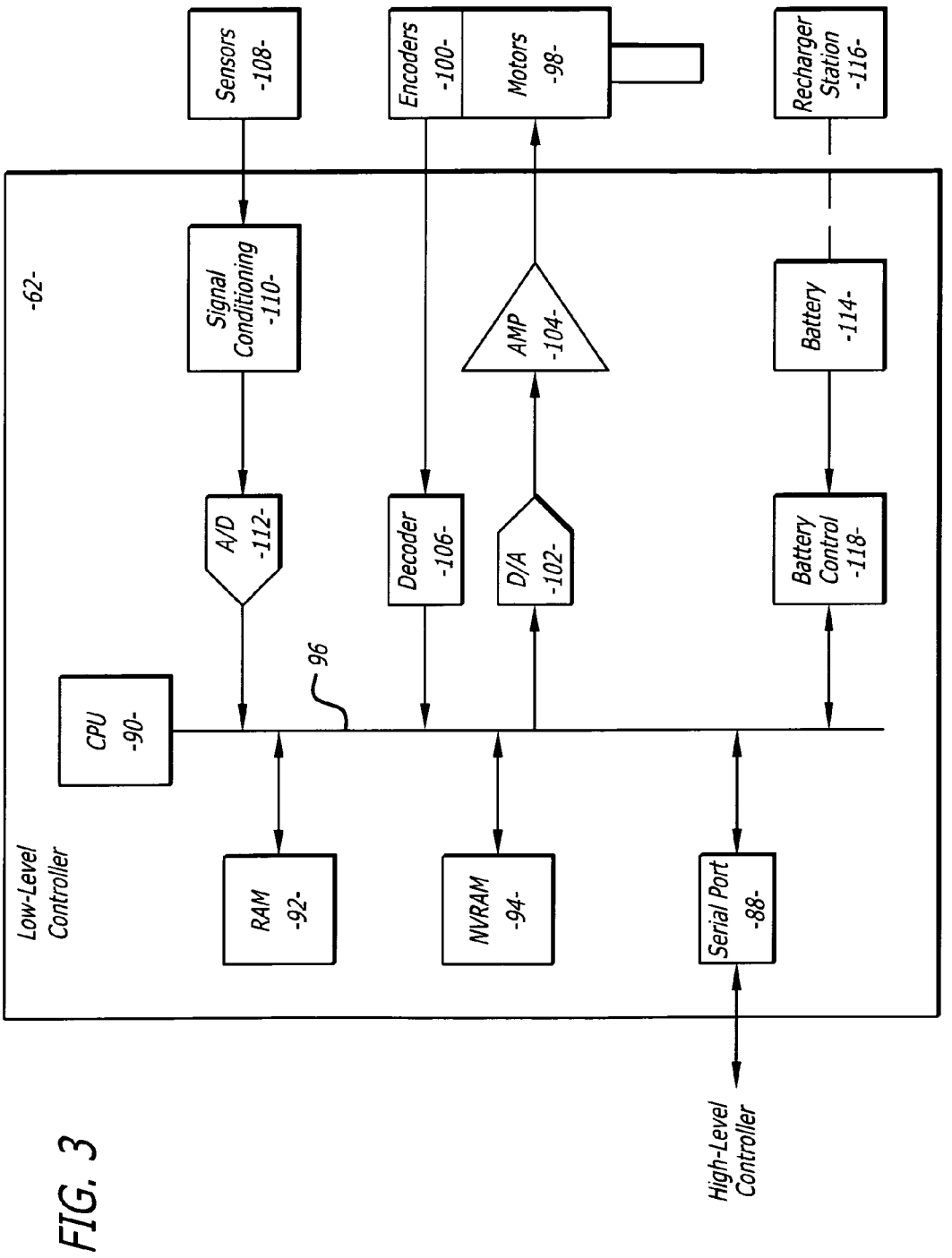

Sensors -108-
Encoders -100-
Motors -98-
Recharger Station -116-
-62-
Signal Conditioning -110-
AMP -104-
Battery -114-
A/D -112-
Decoder -106-
D/A -102-
Battery Control -118-
96
CPU -90-
Low-Level Controller
RAM -92-
NVRAM -94-
Serial Port -88-
High-Level Controller

FIG. 3

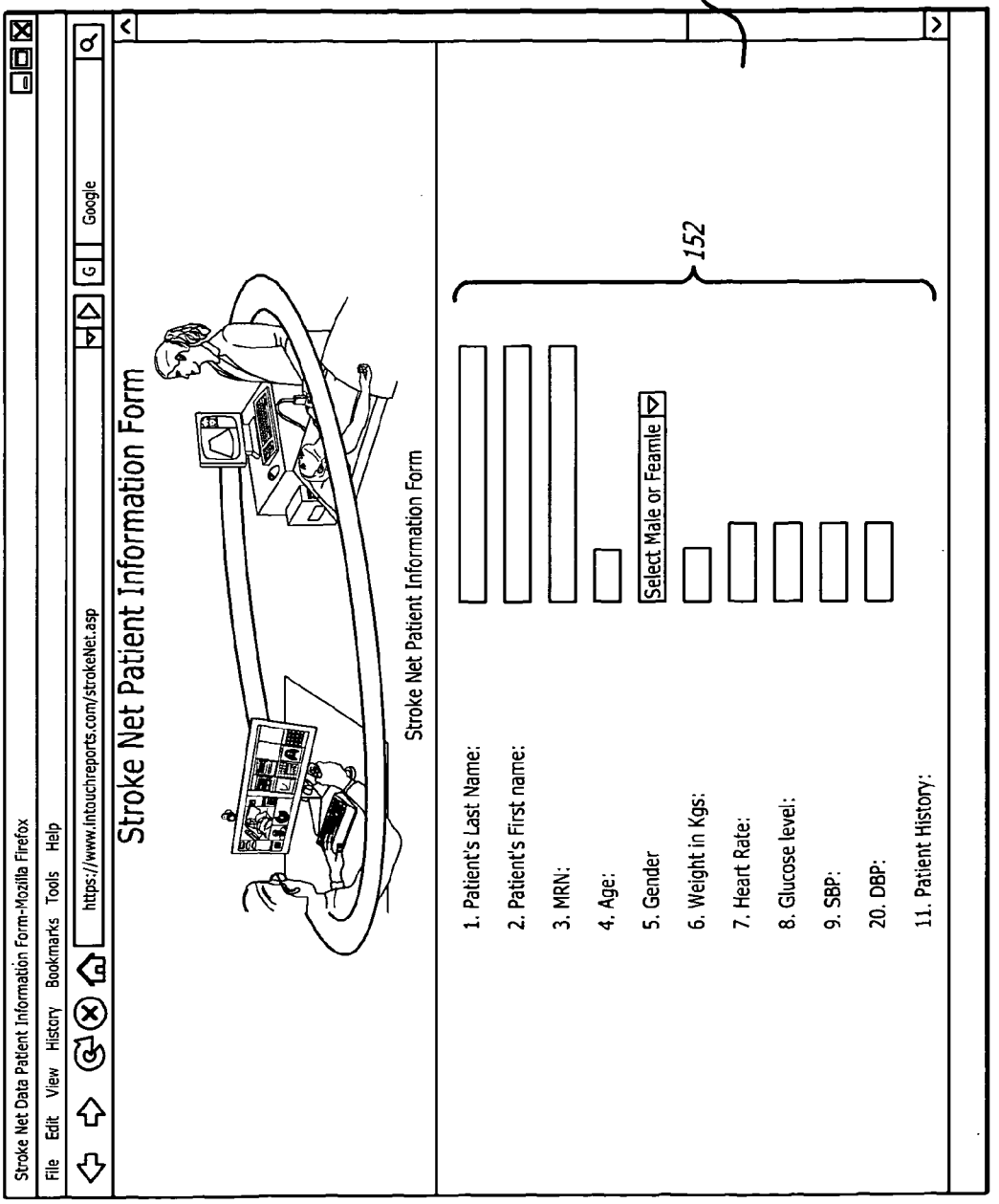

Stroke Net Data Patient Information Form-Mozilla Firefox
File Edit View History Bookmarks Tools Help
https://www.intouchreports.com/strokeNet.asp
Google
Stroke Net Patient Information Form
Stroke Net Patient Information Form
1. Patient's Last Name:
2. Patient's First name:
3. MRN:
4. Age:
5. Gender
Select Male or Feamle
6. Weight in Kgs:
7. Heart Rate:
8. Glucose level:
9. SBP:
20. DBP:
11. Patient History:
150
152

FIG. 4

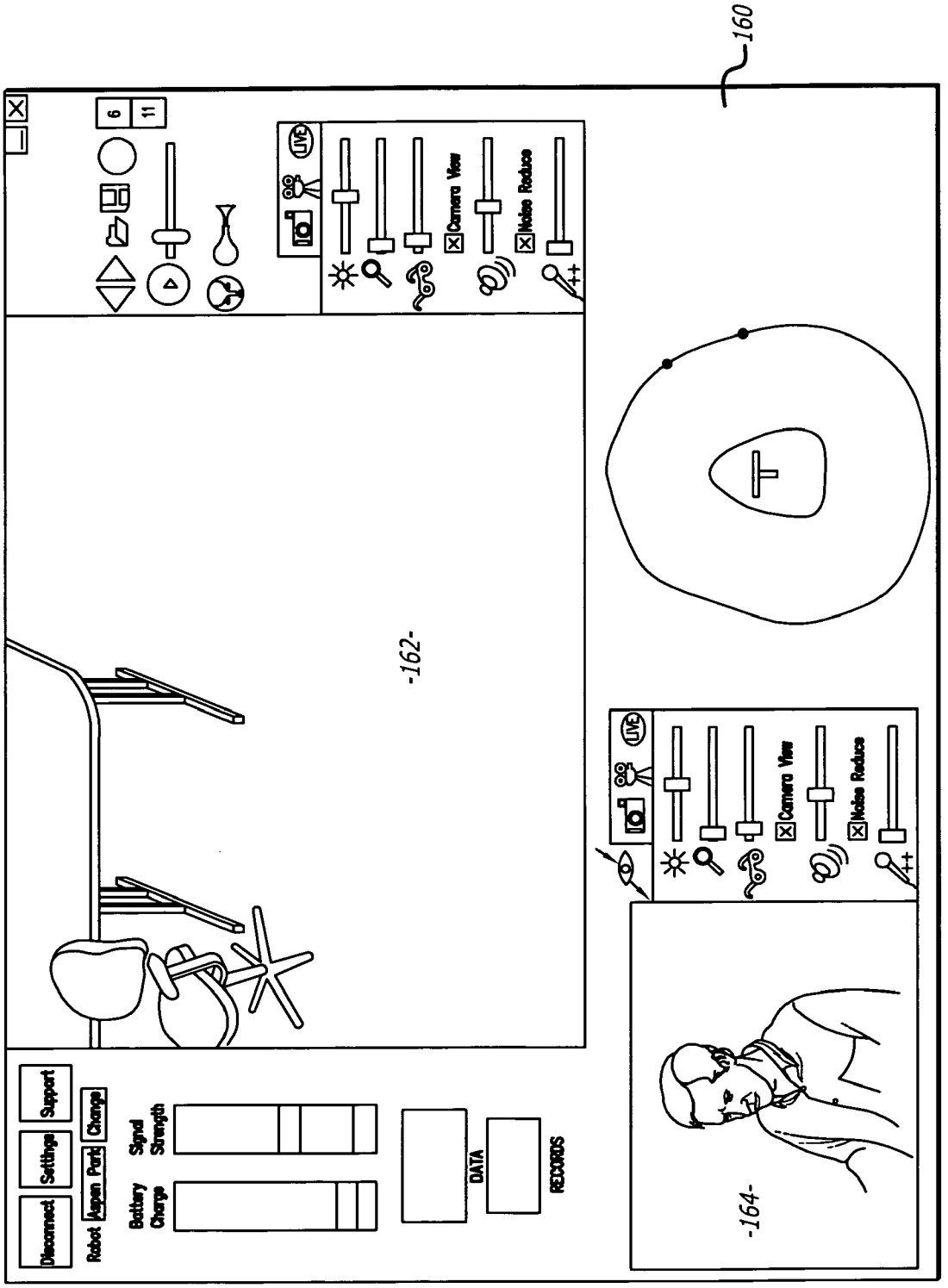

160
-162-
-164-
LIVE
Camera View
Noise Reduce
Support
Settings
Disconnect
Change
Park
Robot
Aspen
Signal Strength
Battery Charge
DATA
RECORDS

FIG. 5

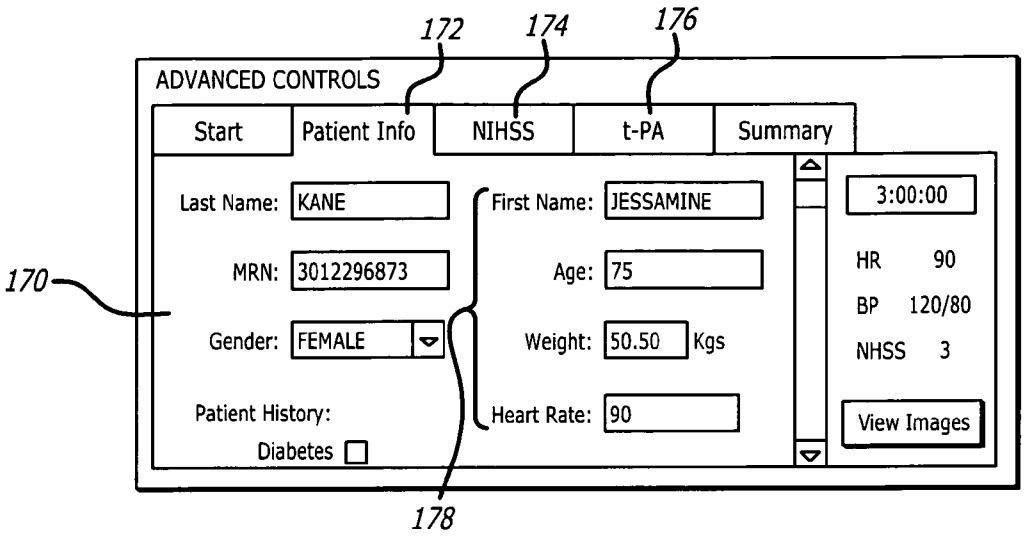

172
174
176
ADVANCED CONTROLS
Start
Patient Info
NIHSS
t-PA
Summary
Last Name: KANE
First Name: JESSAMINE
MRN: 3012296873
Age: 75
Gender: FEMALE
Weight: 50.50 Kgs
Patient History:
Heart Rate: 90
Diabetes
3:00:00
HR 90
BP 120/80
NHSS 3
View Images
170
178

FIG. 6

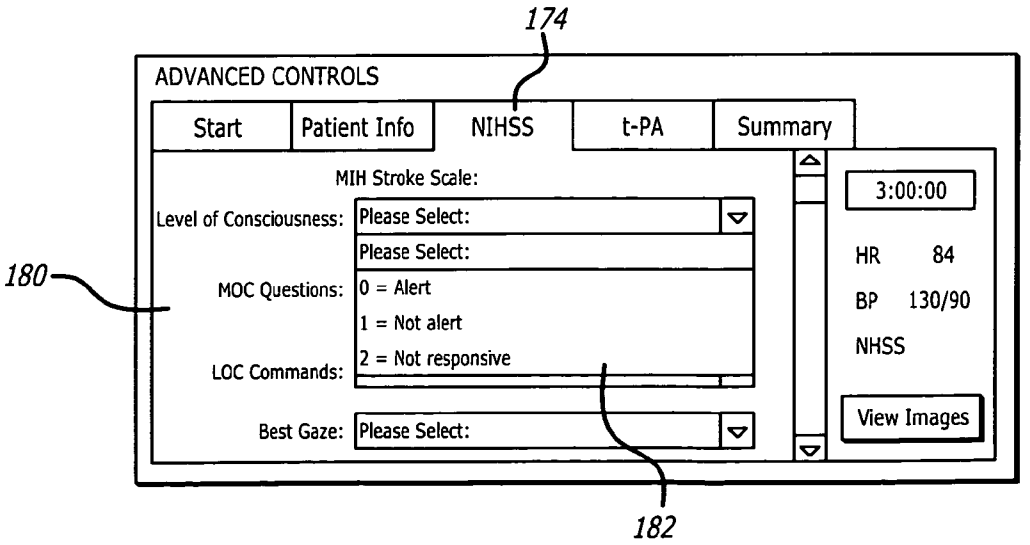

174
ADVANCED CONTROLS
Start
Patient Info
NIHSS
t-PA
Summary
MIH Stroke Scale:
Level of Consciousness: Please Select:
Please Select:
MOC Questions: 0 = Alert
1 = Not alert
LOC Commands: 2 = Not responsive
Best Gaze: Please Select:
3:00:00
HR 84
BP 130/90
NHSS
View Images
180
182

FIG. 7

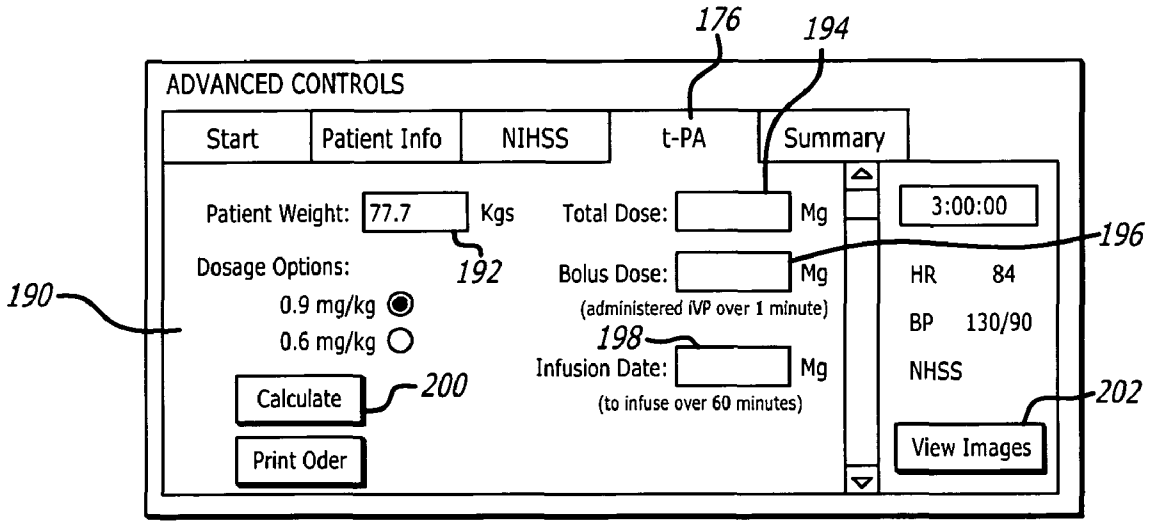

176
194
ADVANCED CONTROLS
Start
Patient Info
NIHSS
t-PA
Summary
Patient Weight:
77.7
Kgs
192
Total Dose:
Mg
Bolus Dose:
Mg
(administered iVP over 1 minute)
198
Infusion Date:
Mg
(to infuse over 60 minutes)
Dosage Options:
0.9 mg/kg
0.6 mg/kg
190
Calculate
200
Print Oder
3:00:00
196
HR 84
BP 130/90
NHSS
202
View Images

FIG. 8

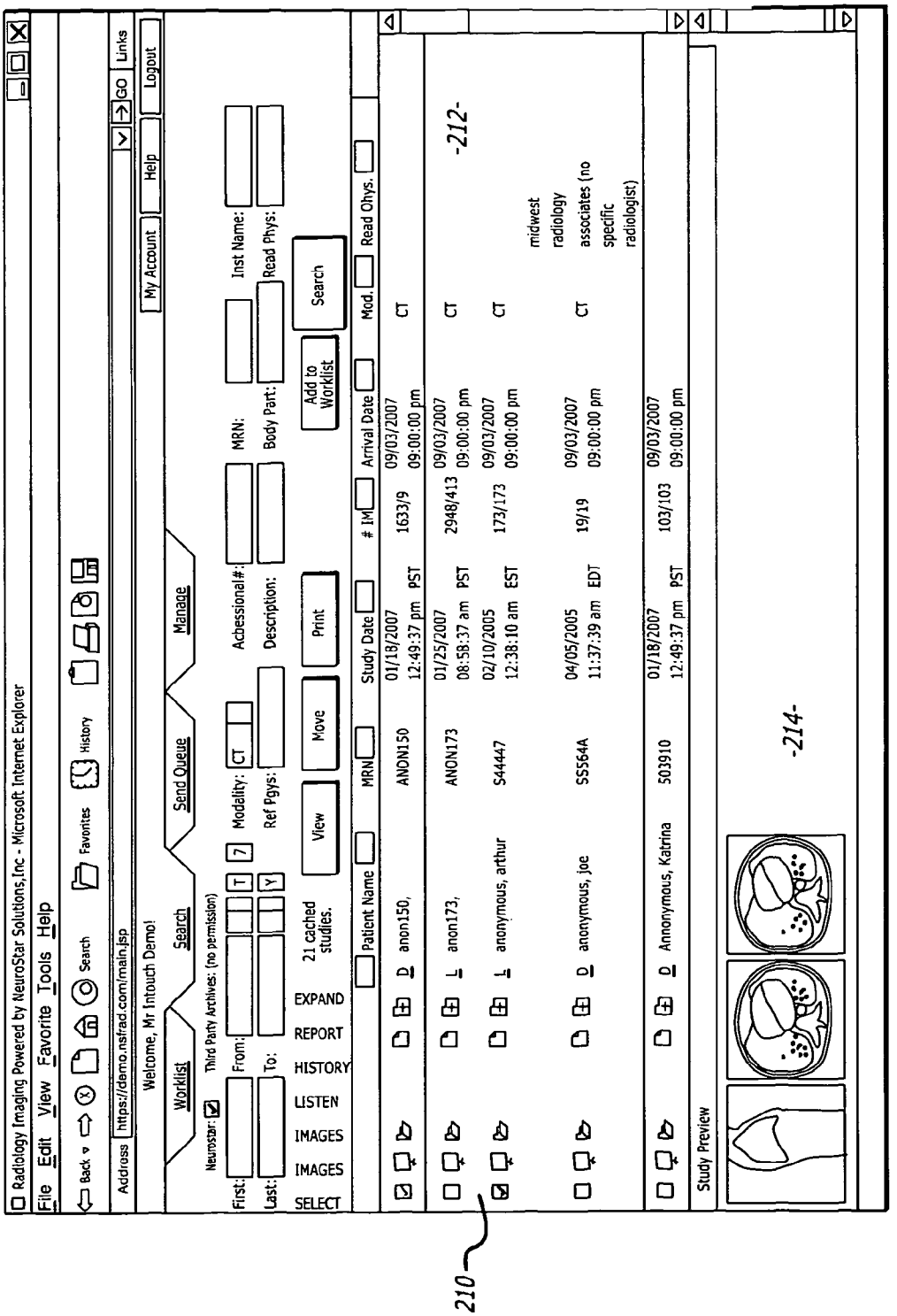

Radiology Imaging Powered by NeuroStar Solutions,Inc - Microsoft Internet Explorer
File Edit View Favorite Tools Help
Address https://demo.nsfrad.com/main.jsp
Links
Welcome, Mr Intouch Demo!
My Account
Help
Logout
Worklist
Search
Send Queue
Manage
Neurostar:
Third Party Archives: (no permission)
First:
Last:
From:
To:
Modality:
Ref Pgys:
Accessional#:
Description:
MRN:
Body Part:
Inst Name:
Read Phys:
21 cached studies.
View
Move
Print
Add to Worklist
Search
EXPAND
REPORT
HISTORY
LISTEN
IMAGES
IMAGES
SELECT
Patient Name
MRN
Study Date
IM
Arrival Date
Mod.
Read Phys.
anon150,
ANON150
01/18/2007 12:49:37 pm PST
1633/9
09/03/2007 09:00:00 pm
CT
anon173,
ANON173
01/25/2007 08:58:37 am PST
2948/413
09/03/2007 09:00:00 pm
CT
midwest radiology associates (no specific radiologist)
anonymous, arthur
S44447
02/10/2005 12:38:10 am EST
173/173
09/03/2007 09:00:00 pm
CT
anonymous, joe
SS564A
04/05/2005 11:37:39 am EDT
19/19
09/03/2007 09:00:00 pm
CT
Annonymous, Katrina
503910
01/18/2007 12:49:37 pm PST
103/103
09/03/2007 09:00:00 pm
Study Preview
210
212
214

FIG. 9

ROBOTIC BASED HEALTH CARE SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the fields of health care and robotics.

2. Background Information

The increasing complexity of healthcare and resulting clinical specialization is causing fragmentation of care compromising patient safety and hospital efficiency. There is the need for availability of clinical specialist expertise to cut across time and space as well as the need for standardization and dissemination of best practices and protocols for optimal quality of care for citizens regardless of where they live.

The need for clinical specialist expertise is especially acute in the diagnosis and treatment of stroke whereby immediate access to expertise and interdisciplinary communication and collaboration is key. Stroke is the second cause of death worldwide and the third leading cause of death in the United States. Recent development of several new therapies including tPA and neuro-endovascular procedures such as coiling offers real hope to change the once bleak prognosis for stroke victims. However, these new therapies are not widely available. Nationally, fewer than 5% of stroke victims are receiving any sort of treatment compared with leading stroke centers where approximately 25% of victims are treated. Most community hospitals do not have the basic patient assessment capability in place on a 24/7 basis nor have they established the appropriate ED treatment protocols. Additionally, only a very few hospitals have the specialists on staff required for neuro-endovascular procedures. Therefore stroke patients are either immediately transferred without proper evaluation or go untreated.

A major challenge in delivering stroke care relates to the time elements of stroke. The adage "time is brain" is often heard. The challenge is to get the right expertise and treatment to the patient at the right time. This encompasses the-entire continuum of care from emergency medical services and ambulance transport to evaluation in the ED and definitive treatment. Some stroke care guidelines have been established by the National Institute for Neurological Disorders and Stroke (NINDS). For example, the guidelines suggest getting a patient with symptoms of stroke to stroke expertise (e.g. neurologist, stroke team activation) within fifteen minutes. The use of the word "expertise" here is significant in that the expert need not be physically present next to the patient but could be made available through a consult, for example, over the phone.

BRIEF SUMMARY OF THE INVENTION

A robotic system that includes a mobile robot that has a camera. The system also includes a user interface that allows medical information to be entered by a user. The mobile robot is coupled to a remote station that can control movement of the robot. The remote station includes a monitor that is coupled to the mobile robot camera and displays the medical information.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a robotic system;

FIG. **2** is a schematic of an electrical system of a robot;

FIG. **3** is a further schematic of the electrical system of the robot;

FIG. **4** is a graphical user interface of a user interface;

FIG. **5** is a graphical user interface at a remote station;

FIG. **6** is a graphical user interface at the remote station;

FIG. **7** is a graphical user interface when a NIHSS tab is selected;

FIG. **8** is a graphical user interface displayed when a t-PA table is selected

FIG. **9** is a graphical user interface displayed when a view images button is selected.

DETAILED DESCRIPTION

Disclosed is a robotic system that can be used to treat a patient. The robotic system includes a mobile robot that has a camera. The mobile robot is controlled by a remote station that has a monitor. A physician can use the remote station to move the mobile robot into view of a patient. An image of the patient is transmitted from the robot camera to the remote station monitor. A medical personnel at the robot site can enter patient information into the system through a user interface. The patient information can stored in a server. The physician can access the information from the remote station. The remote station may provide graphical user interfaces that display the patient information and provide a medical tool. By way of example, the remote station may present to the user a NIHSS questionnaire to determine the severity of a stroke. The graphical user interfaces may include an interface that provides a patient management plan such as a calculated dosage. The medical tool and dosage can be transmitted to the user interface so that this information can be viewed by medical personnel in physical proximity to the patient. The system allows a clinical specialist to remotely observe and treat a patient. This is particularly advantageous when treating stroke patients, where time is critical.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a robotic system **10**. The robotic system **10** includes one or more robots **12**. Each robot **12** has a base station **14**. The robot **12** is coupled to a remote control station **16**. The remote control station **16** may be coupled to the base station **14** through a network **18**. By way of example, the network **18** may be either a packet switched network such as the Internet, or a circuit switched network such has a Public Switched Telephone Network (PSTN) or other broadband system. The base station **14** may be coupled to the network **18** by a modem **20** or other broadband network interface device. By way of example, the base station **14** may be a wireless router. Alternatively, the robot **12** may have a direct connection to the network thru for example a satellite.

The remote control station **16** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **16** is typically located in a place that is remote from the robot **12**. Although only one remote control station **16** is shown, the system **10** may include a plurality of remote stations. In general any number of robots **12** may be controlled by any number of remote stations **16** or other robots **12**. For example, one remote station **16** may be coupled to a plurality of robots **12**, or one robot **12** may be coupled to a plurality of remote stations **16**, or a plurality of robots **12**.

Each robot **12** includes a movement platform **34** that is attached to a robot housing **36**. The robot **12** may also have a camera **38**, a monitor **40**, a microphone(s) **42** and a speaker(s) **44**. The microphone **42** and speaker **30** may create a stereophonic sound. The robot **12** may also have an antenna **46** that is wirelessly coupled to an antenna **48** of the base station **14**. The system **10** allows a user at the remote control station **16** to move the robot **12** through operation of the input device **32**.

The robot camera **38** is coupled to the remote monitor **24** so that a user at the remote station **16** can view a patient. Likewise, the robot monitor **40** is coupled to the remote camera **26** so that the patient can view the user. The microphones **28** and **42**, and speakers **30** and **44**, allow for audible communication between the patient and the user.

The remote station computer **22** may operate Microsoft OS software and WINDOWS XP or other operating systems such as LINUX. The remote computer **22** may also operate a video driver, a camera driver, an audio driver and a joystick driver. The video images may be transmitted and received with compression software such as MPEG CODEC.

The system **10** may include a records server **50** that can be accessed through the network **18**. Patient information can be provided to the server **50** through a user interface **52**. The user interface **52** may or may not be in close proximity to the robot **12**. For example, the user interface may be a computer located at a nurses station where information is entered when a patient checks into a facility. The robot **12** can be moved into view of the patient so that patient information can be entered into the system while a physician is viewing the patient through the robot camera. The physician can remotely move the robot to obtain different viewing angles of the patient. The user interface **52** may be a separate computer terminal. Alternatively, the user interface **52** may be integral with the robot. For example, the robot monitor may be a touch screen that allows a user to enter data into the system through the robot **12**. The server **50** may contain other medical records of a patient such as written records of treatment, patient history, medication information, x-rays, EKGs, laboratory results, physician notes, etc.

The system **10** may also include an image server **54** and a registry server **56**. The image server **54** may include medical images. For example, the medical images may include CT scans of a patient's brain. The images can be downloaded to one of the remote stations **14** through the network **18**. The registry server **56** may store historical data on patients. The historical data can be downloaded to a remote computer **16** through the network **18**.

FIGS. **2** and **3** show an embodiment of a robot **12**. Each robot **12** may include a high level control system **60** and a low level control system **62**. The high level control system **60** may include a processor **64** that is connected to a bus **66**. The bus is coupled to the camera **38** by an input/output (I/O) port **68**, and to the monitor **40** by a serial output port **70** and a VGA driver **72**. The monitor **40** may include a touchscreen function that allows a user to enter input by touching the monitor screen.

The speaker **44** is coupled to the bus **56** by a digital to analog converter **74**. The microphone **42** is coupled to the bus **66** by an analog to digital converter **76**. The high level controller **60** may also contain random access memory (RAM) device **78**, a non-volatile RAM device **80** and a mass storage device **82** that are all coupled to the bus **72**. The mass storage device **82** may contain medical files of the patient that can be accessed by the user at the remote control station **16**. For example, the mass storage device **82** may contain a picture of the patient. The user, particularly a health care provider, can recall the old picture and make a side by side comparison on the monitor **24** with a present video image of the patient provided by the camera **38**. The robot antennae **46** may be coupled to a wireless transceiver **84**. By way of example, the transceiver **84** may transmit and receive information in accordance with IEEE 802.11b.

The controller **64** may operate with a LINUX OS operating system. The controller **64** may also operate MS WINDOWS along with video, camera and audio drivers for communication with the remote control station **16**. Video information may be transceived using MPEG CODEC compression techniques. The software may allow the user to send e-mail to the patient and vice versa, or allow the patient to access the Internet. In general the high level controller **60** operates to control communication between the robot **12** and the remote control station **16**.

The high level controller **60** may be linked to the low level controller **62** by a serial port **88**. The low level controller **62** includes a processor **90** that is coupled to a RAM device **92** and non-volatile RAM device **94** by a bus **96**. Each robot **12** contains a plurality of motors **98** and motor encoders **100**. The encoders **100** provide feedback information regarding the output of the motors **98**. The motors **98** can be coupled to the bus **96** by a digital to analog converter **102** and a driver amplifier **104**. The encoders **100** can be coupled to the bus **86** by a decoder **106**. Each robot **12** may have a number of proximity sensors **108** (see also FIG. **1**). The sensors **108** can be coupled to the bus **96** by a signal conditioning circuit **110** and an analog to digital converter **112**.

The low level controller **62** runs software routines that mechanically actuate the robot **12**. For example, the low level controller **62** provides instructions to actuate the movement platform to move the robot **12**. The low level controller **62** may receive movement instructions from the high level controller **60**. The movement instructions may be received as movement commands from the remote control station or another robot. Although two controllers are shown, it is to be understood that each robot **12** may have one controller, or more than two controllers, controlling the high and low level functions.

The various electrical devices of each robot **12** may be powered by a battery(ies) **114**. The battery **114** may be recharged by a battery recharger station **116** (see also FIG. **1**). The low level controller **62** may include a battery control circuit **118** that senses the power level of the battery **114**. The low level controller **62** can sense when the power falls below a threshold and then send a message to the high level controller **60**.

The system may be the same or similar to a robotic system provided by the assignee InTouch Technology, Inc. of Santa Barbara, Calif. under the name RP-7, which is hereby incorporated by reference. The system may also be the same or similar to the system disclosed in U.S. Pat. No. 7,292,912, which is hereby incorporated by reference.

FIG. **4** shows a graphical user interface **150** provided at the user interface **52**. The graphical user interface **150** includes a plurality of data fields **152** that can be filled by the user. The data fields **152** can request patient information such as name, age, etc. The data fields may also include request for medical data such as heart rate, glucose level and blood pressure ("SBP" and "DBP").

FIG. **5** shows a display user interface ("DUI") **160** that can be displayed at the remote station **14**. The DUI **160** may include a robot view field **162** that displays a video image captured by the camera of the robot. The DUI **160** may also include a station view field **164** that displays a video image provided by the camera of the remote station **14**. The DUI **160** may be part of an application program stored and operated by the computer **22** of the remote station **14**.

FIG. **6** shows a graphical user interface **170** that is displayed by the monitor of the remote station **16**. The interface **170** includes a "PATIENT INFO" tab **172**, a "NIHSS" tab **174** and a "t-PA" tab **176**. Selection of the PATIENT INFO tab **172** displays various data fields **178** including patient name, age, weight, heart rate, etc. This may be the same information through the user interface.

FIG. **7** shows an interface **180** when the "NIHSS" tab **174** is selected. The interface **180** has a data field **182** that provides a questionnaire to rate the severity of a stroke victim using the NIHSS stroke scale. This provides a readily available medical tool for the physician.

FIG. **8** shows an interface **190** when the "t-PA" tab **176** is selected. The interface **190** may include a data field **192** that provides the patient's weight, a "TOTAL DOSE" data field **194**, a "BOLUS DOSE" data field **196** and an "INFUSION DOSE" data field **198**. The interface **190** may also include a "CALCULATE" button **200**. When the CALCULATE button **182** is selected the data fields **194**, **196** and **198** are automatically populated with a calculated dosage. This provides a patient management plan for the physician to review. The interfaces **170**, **180** and **190** also have a "VIEW IMAGES" button **202** that when selected displays an interface **210** shown in FIG. **9**. The interface **210** includes a data field **212** and an image field **214**. The image field **214** can provide a plurality of medical images such as a CT scan of the patient's head.

The system is useful for allowing a physician to remotely view and treat a stroke patient. The system provides patient information, NIHSS stroke severity assessment, calculated t-PA dosage and CT head images that allow the physician to provide real time remote patient treatment.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A robotic system, comprising:
- a mobile robot that has a camera and is located at a robot site;
- a user interface that is located at the robot site and allows medical information to be entered by a user; and,
- a remote station that is coupled to said mobile robot to control movement of said mobile robot, said remote station includes a monitor that is coupled to said mobile robot camera, and displays a graphical user interface that provides said medical information.

2. The system of claim **1**, further comprising a records server that is coupled to said remote station and said user interface and stores said medical information.

3. The system of claim **1**, further comprising an image server that is coupled to said remote station and stores a plurality of medical, images.

4. The system of claim **2**, wherein said medical information includes patient statistics.

5. The system of claim **1**, wherein said remote station provides a medical tool.

6. The system of claim **1**, wherein said remote station provides a graphical user interface that can receive information and display a patient management plan.

7. The system of claim **6**, wherein said medical tool is a stroke evaluation.

8. The system of claim **1**, wherein said user interface is a computer terminal.

9. The system of claim **1**, wherein said mobile robot includes a monitor coupled to a camera of said remote station.

10. The system of claim **9**, wherein said mobile robot includes a speaker and a microphone.

11. A robotic system, comprising:
- a mobile robot that has a camera;
- a user interface that allows patient information and patient statistics to be entered by a user;
- a remote station that is coupled to said mobile robot to control movement of said mobile robot, said remote station includes a monitor that is coupled to said mobile robot camera, and that displays a plurality of graphical user interfaces, said graphical user interfaces provide said patient statistics, a medical tool and a patient management plan.

12. The system of claim **11**, further comprising a records server that is coupled to said remote station and said user interface and stores said patient information and said patient statistics.

13. The system of claim **11**, further comprising an image server that is coupled to said remote station and stores a plurality of medical images.

14. The system of claim **13**, wherein at least one of said graphical user interfaces displays at least one of said medical images.

15. The system of claim **11**, wherein said user interface is a computer terminal.

16. The system of claim **11**, wherein said mobile robot includes a monitor coupled to a camera of said remote station.

17. The system of claim **16**, wherein said mobile robot includes a speaker and a microphone.

18. A method for treating a patient, comprising:
- moving a mobile robot into a vicinity of a patient at a robot site through commands from a remote station;
- viewing the patient at the remote station through a camera of the mobile robot;
- entering information about the patient through a user interface located at the robot site;
- displaying the patient information at the remote station; and,
- displaying a patient management plan at the remote station.

19. The method of claim **18**, further comprising displaying a medical image at the remote station.

20. The method of claim **18**, wherein the patient management plan includes a calculated dosage at the remote station.

21. The method of claim **18**, wherein the patient management plan is a stroke evaluation.

22. A graphical user interface that is displayed on a monitor of a remote station that controls a mobile robot, the mobile robot having a camera, comprising:
- a graphical user interface that includes;
  - a patient information area;
  - a medical assessment area; and,
  - a patient management plan area.

23. The user interface of claim **22**, wherein selection within said medical assessment area causes a display of a NIHSS scale questionnaire.

24. The user interface of claim **22**, wherein selection within said patient management plan area causes a display with input fields and a calculation button that provides a calculated dosage when selected.

* * * * *

Exhibit D

US008849680B2

(12) **United States Patent**
Wright et al.

(10) **Patent No.: US 8,849,680 B2**
(45) **Date of Patent: Sep. 30, 2014**

(54) **DOCUMENTATION THROUGH A REMOTE PRESENCE ROBOT**

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(58) **Field of Classification Search**

USPC 705/2

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995	A	7/1974	Aghnides
4,413,693	A	11/1983	Derby
4,471,354	A	9/1984	Smith
4,519,466	A	5/1985	Shiraishi
4,572,594	A	2/1986	Schwartz
4,625,274	A	11/1986	Schroeder
4,638,445	A	1/1987	Mattaboni
4,652,204	A	3/1987	Arnett
4,669,168	A	6/1987	Tamura et al.
4,679,152	A	7/1987	Perdue
4,697,472	A	10/1987	Hiyane
4,709,265	A	11/1987	Silverman et al.

(Continued)

FOREIGN PATENT DOCUMENTS

AU	1216200	A	5/2000
CA	2289697	A1	11/1998

(Continued)

OTHER PUBLICATIONS

Goldenberg, et al., "Telemedicine in Otolaryngology", American Journal of Otolaryngology, vol. 23, No. 1, 2002, pp. 35-43.

(Continued)

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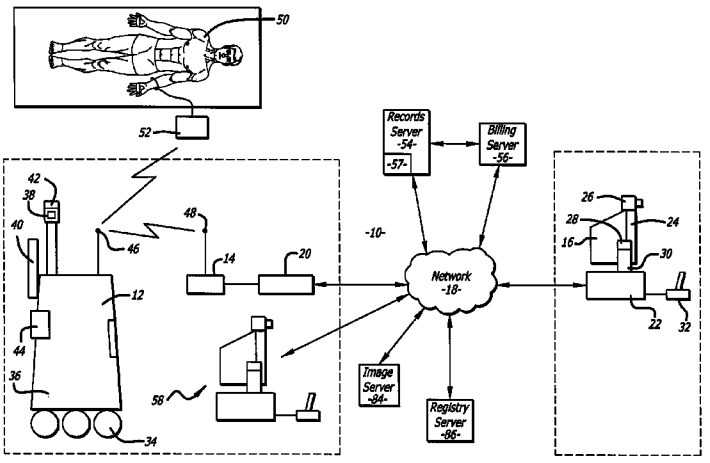
(57) **ABSTRACT**

A robotic system that is used in a tele-presence session. For example, the system can be used by medical personnel to examine, diagnose and prescribe medical treatment in the session. The system includes a robot that has a camera and is controlled by a remote station. The system further includes a storage device that stores session content data regarding the session. The data may include a video/audio taping of the session by the robot. The session content data may also include time stamps that allow a user to determine the times that events occurred during the session. The session content data may be stored on a server that accessible by multiple users. Billing information may be automatically generated using the session content data.

29 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,733,737	A	3/1988	Falamak
4,751,658	A	6/1988	Kadonoff et al.
4,766,581	A	8/1988	Korn et al.
4,777,416	A	10/1988	George, II et al.
4,797,557	A	1/1989	Ohman
4,803,625	A	2/1989	Fu et al.
4,847,764	A	7/1989	Halvorson
4,875,172	A	10/1989	Kanayama
4,878,501	A	11/1989	Shue
4,942,512	A	7/1990	Kohno
4,942,538	A	7/1990	Yuan et al.
4,953,159	A	8/1990	Hayden et al.
4,974,607	A	12/1990	Miwa
4,977,971	A	12/1990	Crane, III et al.
5,006,988	A	4/1991	Borenstein et al.
5,040,116	A	8/1991	Evans et al.
5,051,906	A	9/1991	Evans, Jr. et al.
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,130,794	A	7/1992	Ritchey
5,148,591	A	9/1992	Pryor
5,153,833	A	10/1992	Gordon et al.
5,155,684	A	10/1992	Burke et al.
5,157,491	A	10/1992	Kassatly
5,182,641	A	1/1993	Diner et al.
5,186,270	A	2/1993	West
5,193,143	A	3/1993	Kaemmerer et al.
5,217,453	A	6/1993	Wilk
5,224,157	A	6/1993	Yamada et al.
5,230,023	A	7/1993	Nakano
5,231,693	A	7/1993	Backes et al.
5,236,432	A	8/1993	Matsen, II et al.
5,305,427	A	4/1994	Nagata
5,315,287	A	5/1994	Sol
5,319,611	A	6/1994	Korba
5,341,242	A	8/1994	Gilboa et al.
5,341,459	A	8/1994	Backes
5,341,854	A	8/1994	Zezulka et al.
5,347,306	A	9/1994	Nitta
5,347,457	A	9/1994	Tanaka et al.
5,350,033	A	9/1994	Kraft
5,366,896	A	11/1994	Margrey et al.
5,374,879	A	12/1994	Pin et al.
5,375,195	A	12/1994	Johnston
5,413,693	A	5/1995	Redepenning
5,417,210	A	5/1995	Funda et al.
5,419,008	A	5/1995	West
5,436,542	A	7/1995	Petelin et al.
5,441,042	A	8/1995	Putman
5,441,047	A	8/1995	David et al.
5,442,728	A	8/1995	Kaufman et al.
5,462,051	A	10/1995	Oka et al.
5,486,853	A	1/1996	Baxter et al.
5,510,832	A	4/1996	Garcia
5,511,147	A	4/1996	Abdel-Malek
5,528,289	A	6/1996	Cortjens et al.
5,539,741	A	7/1996	Barraclough et al.
5,544,649	A	8/1996	David et al.
5,550,577	A	8/1996	Verbiest et al.
5,553,609	A	9/1996	Chen et al.
5,563,998	A	10/1996	Yaksich et al.
5,572,229	A	11/1996	Fisher
5,572,999	A	11/1996	Funda et al.
5,594,859	A	1/1997	Palmer et al.
5,600,573	A	2/1997	Hendricks et al.
5,630,566	A	5/1997	Case
5,636,218	A	6/1997	Ishikawa
5,652,849	A	7/1997	Conway et al.
5,657,246	A	8/1997	Hogan et al.
5,659,779	A	8/1997	Laird et al.
5,673,082	A	9/1997	Wells et al.
5,675,229	A	10/1997	Thorne
5,682,199	A	10/1997	Lankford
5,684,695	A	11/1997	Bauer
5,701,904	A	12/1997	Simmons et al.
5,739,657	A	4/1998	Takayama et al.
5,748,629	A	5/1998	Caldara et al.
5,749,058	A	5/1998	Hashimoto
5,749,362	A	5/1998	Funda et al.
5,754,631	A	5/1998	Cave
5,758,079	A	5/1998	Ludwig et al.
5,762,458	A	6/1998	Wang et al.
5,764,731	A	6/1998	Yablon
5,767,897	A	6/1998	Howell
5,786,846	A	7/1998	Hiroaki
5,787,545	A	8/1998	Colens
5,802,494	A	9/1998	Kuno
5,836,872	A	11/1998	Kenet et al.
5,838,575	A	11/1998	Lion
5,857,534	A	1/1999	DeVault et al.
5,867,653	A	2/1999	Aras et al.
5,871,451	A	2/1999	Unger et al.
5,876,325	A	3/1999	Mizuno et al.
5,911,036	A	6/1999	Wright et al.
5,917,958	A	6/1999	Nunally et al.
5,927,423	A	7/1999	Wada et al.
5,949,758	A	9/1999	Kober
5,954,692	A	9/1999	Smith et al.
5,959,423	A	9/1999	Nakanishi et al.
5,961,446	A	10/1999	Beller et al.
5,966,130	A	10/1999	Benman, Jr.
5,973,724	A	10/1999	Riddle
5,974,446	A	10/1999	Sonnenreich et al.
5,983,263	A	11/1999	Rothrock et al.
5,995,119	A	11/1999	Cosatto et al.
5,995,884	A	11/1999	Allen et al.
5,999,977	A	12/1999	Riddle
6,006,946	A	12/1999	Williams et al.
6,031,845	A	2/2000	Walding
6,036,812	A	3/2000	Williams et al.
6,047,259	A	4/2000	Campbell et al.
6,113,343	A	9/2000	Goldenberg et al.
6,133,944	A	10/2000	Braun et al.
6,135,228	A	10/2000	Asada et al.
6,148,100	A	11/2000	Anderson et al.
6,160,582	A	12/2000	Hill
6,170,929	B1	1/2001	Wilson et al.
6,175,779	B1	1/2001	Barrett
6,201,984	B1	3/2001	Funda et al.
6,211,903	B1	4/2001	Bullister
6,219,587	B1	4/2001	Ahlin et al.
6,232,735	B1	5/2001	Baba et al.
6,233,504	B1	5/2001	Das et al.
6,233,735	B1	5/2001	Ebihara
6,250,928	B1	6/2001	Poggio et al.
6,256,556	B1	7/2001	Zenke
6,259,806	B1	7/2001	Green
6,259,956	B1	7/2001	Myers et al.
6,266,162	B1	7/2001	Okamura et al.
6,266,577	B1	7/2001	Popp et al.
6,289,263	B1	9/2001	Mukherjee
6,292,713	B1	9/2001	Jouppi et al.
6,304,050	B1	10/2001	Skaar et al.
6,317,652	B1	11/2001	Osada
6,321,137	B1	11/2001	De Smet
6,324,184	B1	11/2001	Hou et al.
6,324,443	B1	11/2001	Kurakake et al.
6,325,756	B1	12/2001	Webb et al.
6,327,516	B1	12/2001	Zenke
6,330,486	B1	12/2001	Padula
6,330,493	B1	12/2001	Takahashi et al.
6,346,950	B1	2/2002	Jouppi
6,346,962	B1	2/2002	Goodridge
6,369,847	B1	4/2002	James et al.
6,381,515	B1	4/2002	Inoue et al.
6,400,378	B1	6/2002	Snook
6,408,230	B2	6/2002	Wada
6,430,471	B1	8/2002	Kintou et al.
6,430,475	B2	8/2002	Okamoto et al.
6,438,457	B1	8/2002	Yokoo et al.
6,445,964	B1	9/2002	White et al.
6,449,762	B1	9/2002	McElvain
6,452,915	B1	9/2002	Jorgensen
6,457,043	B1	9/2002	Kwak et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,459,955 B1 10/2002 Bartsch et al.
6,463,352 B1 10/2002 Tadokoro et al.
6,463,361 B1 10/2002 Wang et al.
6,466,844 B1 10/2002 Ikeda et al.
6,468,265 B1 10/2002 Evans et al.
6,470,235 B2 10/2002 Kasuga et al.
6,474,434 B1 11/2002 Bech
6,480,762 B1 11/2002 Uchikubo et al.
6,491,701 B2 12/2002 Tierney et al.
6,496,099 B2 12/2002 Wang et al.
6,496,755 B2 12/2002 Wallach et al.
6,501,740 B1 12/2002 Sun et al.
6,507,773 B2 1/2003 Parker et al.
6,522,906 B1 2/2003 Salisbury et al.
6,523,629 B1 2/2003 Buttz et al.
6,526,332 B2 2/2003 Sakamoto et al.
6,529,765 B1 3/2003 Franck et al.
6,529,802 B1 3/2003 Kawakita et al.
6,532,404 B2 3/2003 Colens
6,535,182 B2 3/2003 Stanton
6,535,793 B2 3/2003 Allard
6,540,039 B1 4/2003 Yu et al.
6,543,899 B2 4/2003 Covannon et al.
6,549,215 B2 4/2003 Jouppi
6,563,533 B1 5/2003 Colby
6,580,246 B2 6/2003 Jacobs
6,581,798 B2 6/2003 Liff et al.
6,584,376 B1 6/2003 Van Kommer
6,587,750 B2 7/2003 Gerbi et al.
6,594,269 B1 7/2003 Polcyn
6,594,552 B1 7/2003 Nowlin et al.
6,602,469 B1 8/2003 Maus et al.
6,604,019 B2 8/2003 Ahlin et al.
6,604,021 B2 8/2003 Imai et al.
6,611,120 B2 8/2003 Song et al.
6,643,496 B1 11/2003 Shimoyama et al.
6,646,677 B2 11/2003 Noro et al.
6,650,748 B1 11/2003 Edwards et al.
6,666,374 B1 12/2003 Green et al.
6,684,129 B2 1/2004 Salisbury et al.
6,691,000 B2 2/2004 Nagai et al.
6,710,797 B1 3/2004 McNelley et al.
6,728,599 B2 4/2004 Wang
6,763,282 B2 7/2004 Glenn et al.
6,764,373 B1 7/2004 Osawa et al.
6,769,771 B2 8/2004 Trumbull
6,781,606 B2 8/2004 Jouppi
6,784,916 B2 8/2004 Smith
6,785,589 B2 8/2004 Eggenberger et al.
6,791,550 B2 9/2004 Goldhor et al.
6,798,753 B1 9/2004 Doganata et al.
6,799,065 B1 9/2004 Niemeyer
6,799,088 B2 9/2004 Wang et al.
6,804,580 B1 10/2004 Stoddard et al.
6,804,656 B1 10/2004 Rosenfeld et al.
6,810,411 B1 10/2004 Coughlin et al.
6,836,703 B2 12/2004 Wang et al.
6,839,612 B2 1/2005 Sanchez et al.
6,840,904 B2 1/2005 Goldberg
6,845,297 B2 1/2005 Allard
6,852,107 B2 2/2005 Wang et al.
6,853,878 B2 2/2005 Hirayama et al.
6,853,880 B2 2/2005 Sakagami et al.
6,871,117 B2 3/2005 Wang et al.
6,879,879 B2 4/2005 Jouppi et al.
6,888,333 B2 5/2005 Laby
6,892,112 B2 5/2005 Wang et al.
6,895,305 B2 5/2005 Lathan et al.
6,898,484 B2 5/2005 Lemelson et al.
6,914,622 B1 7/2005 Smith et al.
6,925,357 B2 8/2005 Wang et al.
6,951,535 B2 * 10/2005 Ghodoussi et al. 600/101
6,952,470 B1 10/2005 Tioe et al.
6,957,712 B2 10/2005 Song et al.
6,958,706 B2 10/2005 Chaco et al.
6,965,394 B2 11/2005 Gutta et al.
6,995,664 B1 2/2006 Darling
7,007,235 B1 2/2006 Hussein et al.
7,015,934 B2 3/2006 Toyama et al.
RE39,080 E 4/2006 Johnston
7,030,757 B2 4/2006 Matsuhira et al.
7,058,689 B2 6/2006 Parker et al.
7,092,001 B2 8/2006 Schulz
7,096,090 B1 8/2006 Zweig
7,115,102 B2 10/2006 Abbruscato
7,117,067 B2 10/2006 McLurkin et al.
7,123,285 B2 10/2006 Smith et al.
7,123,974 B1 10/2006 Hamilton
7,123,991 B2 10/2006 Graf et al.
7,127,325 B2 10/2006 Nagata et al.
7,129,970 B2 10/2006 James et al.
7,133,062 B2 11/2006 Castles
7,142,945 B2 11/2006 Wang et al.
7,142,947 B2 11/2006 Wang et al.
7,151,982 B2 12/2006 Liff et al.
7,154,526 B2 12/2006 Foote et al.
7,155,306 B2 12/2006 Haitin et al.
7,156,809 B2 1/2007 Quy
7,158,859 B2 1/2007 Wang et al.
7,158,860 B2 1/2007 Wang et al.
7,158,861 B2 1/2007 Wang et al.
7,161,322 B2 1/2007 Wang et al.
7,162,338 B2 1/2007 Goncalves et al.
7,164,969 B2 1/2007 Wang et al.
7,164,970 B2 1/2007 Wang et al.
7,167,448 B2 1/2007 Wookey et al.
7,171,286 B2 1/2007 Wang et al.
7,174,238 B1 2/2007 Zweig
7,181,455 B2 2/2007 Wookey et al.
7,184,559 B2 2/2007 Jouppi
7,188,000 B2 3/2007 Chiappetta et al.
7,199,790 B2 4/2007 Rosenberg et al.
7,202,851 B2 4/2007 Cunningham et al.
7,206,627 B2 4/2007 Abovitz et al.
7,215,786 B2 5/2007 Nakadai
7,227,334 B2 6/2007 Yang et al.
7,256,708 B2 8/2007 Rosenfeld
7,262,573 B2 8/2007 Wang et al.
7,289,883 B2 10/2007 Wang et al.
7,292,912 B2 11/2007 Wang et al.
7,317,685 B1 1/2008 Flott et al.
7,321,807 B2 1/2008 Laski
7,346,429 B2 3/2008 Goldenberg et al.
7,382,399 B1 6/2008 McCall et al.
7,386,730 B2 6/2008 Uchikubo
7,391,432 B2 6/2008 Terada
7,400,578 B2 7/2008 Guthrie et al.
7,404,140 B2 7/2008 O'rourke
7,421,470 B2 9/2008 Ludwig et al.
7,430,209 B2 9/2008 Porter
7,432,949 B2 10/2008 Remy et al.
7,433,921 B2 10/2008 Ludwig et al.
7,441,953 B2 10/2008 Banks
7,492,731 B2 2/2009 Hagendorf
7,523,069 B1 4/2009 Friedl et al.
7,525,281 B2 4/2009 Koyanagi et al.
7,535,486 B2 5/2009 Motomura et al.
7,587,512 B2 9/2009 Ta et al.
7,590,060 B2 9/2009 Miceli
7,593,030 B2 9/2009 Wang et al.
7,599,290 B2 10/2009 Dos Remedios et al.
7,624,166 B2 11/2009 Foote et al.
7,630,314 B2 12/2009 Dos Remedios et al.
7,643,051 B2 1/2010 Sandberg et al.
7,647,320 B2 1/2010 Mok et al.
7,680,038 B1 3/2010 Gourlay
7,693,757 B2 4/2010 Zimmerman
7,698,432 B2 4/2010 Short et al.
7,719,229 B2 5/2010 Kaneko et al.
7,739,383 B1 6/2010 Short et al.
7,756,614 B2 7/2010 Jouppi
7,761,185 B2 7/2010 Wang et al.
7,769,492 B2 8/2010 Wang et al.
7,769,705 B1 8/2010 Luechtefeld

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,813,836 B2 10/2010 Wang et al.
7,831,575 B2 11/2010 Trossell et al.
7,835,775 B2 11/2010 Sawayama et al.
7,860,680 B2 12/2010 Arms et al.
7,890,382 B2 2/2011 Robb et al.
7,912,583 B2 3/2011 Gutmann et al.
RE42,288 E 4/2011 Degioanni
7,924,323 B2 4/2011 Walker et al.
7,949,616 B2 5/2011 Levy et al.
7,982,763 B2 7/2011 King
7,987,069 B2 7/2011 Rodgers et al.
8,077,963 B2 12/2011 Wang et al.
8,116,910 B2 2/2012 Walters et al.
8,170,241 B2 5/2012 Roe et al.
8,179,418 B2 5/2012 Wright et al.
8,180,486 B2 5/2012 Saito et al.
8,209,051 B2 6/2012 Wang et al.
8,265,793 B2 9/2012 Cross et al.
8,292,807 B2 10/2012 Perkins et al.
8,340,654 B2 12/2012 Bratton et al.
8,340,819 B2 12/2012 Mangaser et al.
8,463,435 B2 6/2013 Herzog et al.
8,503,340 B1 8/2013 Xu
8,527,094 B2 9/2013 Kumar et al.
8,532,860 B2 9/2013 Daly
2001/0002448 A1 5/2001 Wilson et al.
2001/0010053 A1 7/2001 Ben-Shachar et al.
2001/0020200 A1 9/2001 Das et al.
2001/0034475 A1 10/2001 Flach et al.
2001/0034544 A1 10/2001 Mo
2001/0037163 A1 11/2001 Allard
2001/0048464 A1 12/2001 Barnett
2001/0051881 A1* 12/2001 Filler 705/3
2001/0054071 A1 12/2001 Loeb
2001/0055373 A1 12/2001 Yamashita
2002/0015296 A1 2/2002 Howell
2002/0027597 A1 3/2002 Sachau
2002/0027652 A1 3/2002 Paromtchik et al.
2002/0033880 A1 3/2002 Sul et al.
2002/0038168 A1 3/2002 Kasuga et al.
2002/0049517 A1 4/2002 Ruffner
2002/0055917 A1 5/2002 Muraca
2002/0057279 A1 5/2002 Jouppi
2002/0058929 A1 5/2002 Green
2002/0059587 A1 5/2002 Cofano et al.
2002/0063726 A1 5/2002 Jouppi
2002/0073429 A1 6/2002 Beane et al.
2002/0082498 A1 6/2002 Wendt et al.
2002/0085030 A1 7/2002 Ghani
2002/0095238 A1 7/2002 Ahlin et al.
2002/0095239 A1 7/2002 Wallach et al.
2002/0098879 A1 7/2002 Rheey
2002/0104094 A1 8/2002 Alexander et al.
2002/0109770 A1 8/2002 Terada
2002/0111988 A1 8/2002 Sato
2002/0120362 A1 8/2002 Lathan et al.
2002/0130950 A1 9/2002 James et al.
2002/0133062 A1 9/2002 Arling et al.
2002/0141595 A1 10/2002 Jouppi
2002/0143923 A1 10/2002 Alexander
2002/0177925 A1 11/2002 Onishi et al.
2002/0183894 A1 12/2002 Wang et al.
2002/0184674 A1 12/2002 Xi et al.
2002/0186243 A1 12/2002 Ellis et al.
2003/0021107 A1 1/2003 Howell et al.
2003/0030397 A1 2/2003 Simmons
2003/0048481 A1 3/2003 Kobayashi et al.
2003/0050733 A1 3/2003 Wang et al.
2003/0050734 A1 3/2003 Lapham
2003/0060808 A1 3/2003 Wilk
2003/0063600 A1 4/2003 Noma et al.
2003/0069752 A1 4/2003 Ledain et al.
2003/0100892 A1 5/2003 Morley et al.
2003/0104806 A1 6/2003 Ruef et al.
2003/0114962 A1 6/2003 Niemeyer
2003/0126361 A1 7/2003 Slater et al.
2003/0135203 A1 7/2003 Wang et al.
2003/0144579 A1 7/2003 Buss
2003/0144649 A1 7/2003 Ghodoussi et al.
2003/0151658 A1 8/2003 Smith
2003/0152145 A1 8/2003 Kawakita
2003/0171710 A1 9/2003 Bassuk et al.
2003/0174285 A1 9/2003 Trumbull
2003/0180697 A1 9/2003 Kim et al.
2003/0199000 A1 10/2003 Valkirs et al.
2003/0206242 A1 11/2003 Choi
2003/0212472 A1 11/2003 McKee
2003/0216834 A1 11/2003 Allard
2003/0220541 A1 11/2003 Salisbury et al.
2003/0220715 A1 11/2003 Kneifel, II et al.
2003/0231244 A1 12/2003 Bonilla et al.
2003/0232649 A1 12/2003 Gizis et al.
2003/0236590 A1 12/2003 Park et al.
2004/0001197 A1 1/2004 Ko et al.
2004/0001676 A1 1/2004 Colgan et al.
2004/0010344 A1 1/2004 Hiratsuka et al.
2004/0012362 A1 1/2004 Tsurumi
2004/0013295 A1 1/2004 Sabe et al.
2004/0019406 A1* 1/2004 Wang et al. 700/231
2004/0024490 A1 2/2004 McLurkin et al.
2004/0041904 A1 3/2004 Lapalme et al.
2004/0065073 A1 4/2004 Nash
2004/0068657 A1 4/2004 Alexander et al.
2004/0078219 A1 4/2004 Kaylor et al.
2004/0080610 A1 4/2004 James et al.
2004/0088077 A1 5/2004 Jouppi et al.
2004/0093409 A1 5/2004 Thompson et al.
2004/0095516 A1 5/2004 Rohlicek
2004/0098167 A1 5/2004 Yi et al.
2004/0102167 A1 5/2004 Shim et al.
2004/0107254 A1 6/2004 Ludwig et al.
2004/0107255 A1 6/2004 Ludwig et al.
2004/0117065 A1* 6/2004 Wang et al. 700/245
2004/0123158 A1 6/2004 Roskind
2004/0135879 A1 7/2004 Stacy et al.
2004/0138547 A1 7/2004 Wang et al.
2004/0143421 A1 7/2004 Wang et al.
2004/0148638 A1 7/2004 Weisman et al.
2004/0153211 A1 8/2004 Kamoto et al.
2004/0157612 A1 8/2004 Kim
2004/0162637 A1 8/2004 Wang et al.
2004/0167666 A1 8/2004 Wang et al.
2004/0167668 A1 8/2004 Wang et al.
2004/0170300 A1 9/2004 Jouppi
2004/0172301 A1 9/2004 Mihai et al.
2004/0172306 A1 9/2004 Wohl et al.
2004/0174129 A1 9/2004 Wang et al.
2004/0175684 A1 9/2004 Kaasa et al.
2004/0179714 A1 9/2004 Jouppi et al.
2004/0186623 A1 9/2004 Dooley et al.
2004/0189700 A1 9/2004 Mandavilli et al.
2004/0201602 A1 10/2004 Mody et al.
2004/0205664 A1 10/2004 Prendergast
2004/0215490 A1 10/2004 Duchon et al.
2004/0222638 A1 11/2004 Bednyak
2004/0224676 A1 11/2004 Iseki
2004/0230340 A1 11/2004 Fukuchi et al.
2004/0240981 A1 12/2004 Dothan et al.
2004/0241981 A1 12/2004 Doris et al.
2005/0003330 A1 1/2005 Asgarinejad
2005/0004708 A1 1/2005 Goldenberg et al.
2005/0007445 A1 1/2005 Foote et al.
2005/0013149 A1 1/2005 Trossell
2005/0021182 A1 1/2005 Wang et al.
2005/0021183 A1 1/2005 Wang et al.
2005/0021187 A1 1/2005 Wang et al.
2005/0021309 A1 1/2005 Alexander et al.
2005/0024485 A1 2/2005 Castles et al.
2005/0027567 A1 2/2005 Taha
2005/0027794 A1 2/2005 Decker
2005/0028221 A1 2/2005 Liu et al.
2005/0035862 A1 2/2005 Wildman et al.
2005/0038416 A1 2/2005 Wang et al.
2005/0038564 A1 2/2005 Burick et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0049898 A1 3/2005 Hirakawa
2005/0052527 A1* 3/2005 Remy et al. 348/14.08
2005/0060211 A1 3/2005 Xiao et al.
2005/0065435 A1 3/2005 Rauch et al.
2005/0065438 A1 3/2005 Miller
2005/0065659 A1 3/2005 Tanaka et al.
2005/0065813 A1 3/2005 Mishelevich et al.
2005/0071046 A1 3/2005 Miyazaki et al.
2005/0078816 A1 4/2005 Sekiguchi et al.
2005/0083011 A1 4/2005 Yang et al.
2005/0099493 A1 5/2005 Chew
2005/0104964 A1 5/2005 Bovyrin et al.
2005/0110867 A1 5/2005 Schulz
2005/0122390 A1 6/2005 Wang et al.
2005/0125098 A1 6/2005 Wang et al.
2005/0154265 A1 7/2005 Miro et al.
2005/0182322 A1 8/2005 Grispo
2005/0192721 A1 9/2005 Jouppi
2005/0204438 A1 9/2005 Wang et al.
2005/0212478 A1 9/2005 Takenaka
2005/0219356 A1 10/2005 Smith et al.
2005/0225634 A1 10/2005 Brunetti et al.
2005/0231156 A1 10/2005 Yan
2005/0231586 A1 10/2005 Rodman et al.
2005/0232647 A1 10/2005 Takenaka
2005/0234592 A1 10/2005 McGee et al.
2005/0267826 A1 12/2005 Levy et al.
2005/0283414 A1 12/2005 Fernandes et al.
2006/0007943 A1 1/2006 Fellman
2006/0013263 A1 1/2006 Fellman
2006/0013469 A1 1/2006 Wang et al.
2006/0013488 A1 1/2006 Inoue
2006/0014388 A1 1/2006 Lur et al.
2006/0020694 A1 1/2006 Nag et al.
2006/0029065 A1 2/2006 Fellman
2006/0047365 A1 3/2006 Ghodoussi et al.
2006/0048286 A1 3/2006 Donato
2006/0052676 A1 3/2006 Wang et al.
2006/0052684 A1 3/2006 Takahashi et al.
2006/0064212 A1 3/2006 Thorne
2006/0074525 A1 4/2006 Close et al.
2006/0074719 A1 4/2006 Horner
2006/0082642 A1 4/2006 Wang et al.
2006/0087746 A1 4/2006 Lipow
2006/0095158 A1 5/2006 Lee et al.
2006/0095170 A1 5/2006 Yang et al.
2006/0098573 A1 5/2006 Beer et al.
2006/0103659 A1 5/2006 Karandikar et al.
2006/0104279 A1 5/2006 Fellman et al.
2006/0106493 A1 5/2006 Niemeyer et al.
2006/0122482 A1 6/2006 Mariotti et al.
2006/0125356 A1 6/2006 Meek, Jr. et al.
2006/0142983 A1 6/2006 Sorensen
2006/0149418 A1 7/2006 Anvari
2006/0161136 A1 7/2006 Anderson et al.
2006/0161303 A1 7/2006 Wang et al.
2006/0164546 A1 7/2006 Adachi
2006/0171515 A1 8/2006 Hintermeister et al.
2006/0173708 A1 8/2006 Vining et al.
2006/0173712 A1 8/2006 Joubert
2006/0178776 A1 8/2006 Feingold et al.
2006/0178777 A1 8/2006 Park et al.
2006/0189393 A1 8/2006 Edery
2006/0195569 A1 8/2006 Barker
2006/0224781 A1 10/2006 Tsao et al.
2006/0247045 A1 11/2006 Jeong et al.
2006/0259193 A1 11/2006 Wang et al.
2006/0268704 A1 11/2006 Ansari et al.
2006/0271238 A1 11/2006 Choi et al.
2006/0271400 A1 11/2006 Clements et al.
2006/0293788 A1 12/2006 Pogodin
2007/0021871 A1 1/2007 Wang et al.
2007/0025711 A1 2/2007 Marcus
2007/0046237 A1 3/2007 Lakshmanan et al.
2007/0050937 A1 3/2007 Song et al.
2007/0064092 A1 3/2007 Sandbeg et al.
2007/0078566 A1 4/2007 Wang et al.
2007/0112700 A1 5/2007 Den et al.
2007/0117516 A1 5/2007 Saidi et al.
2007/0120965 A1 5/2007 Sandberg et al.
2007/0122783 A1 5/2007 Habashi
2007/0133407 A1 6/2007 Choi et al.
2007/0135967 A1 6/2007 Jung et al.
2007/0142964 A1 6/2007 Abramson
2007/0176060 A1 8/2007 White et al.
2007/0192910 A1 8/2007 Vu et al.
2007/0197896 A1 8/2007 Moll et al.
2007/0198128 A1 8/2007 Ziegler et al.
2007/0198130 A1 8/2007 Wang et al.
2007/0199108 A1 8/2007 Angle et al.
2007/0216347 A1 9/2007 Kaneko et al.
2007/0250212 A1 10/2007 Halloran et al.
2007/0255706 A1 11/2007 Iketani et al.
2007/0262884 A1 11/2007 Goncalves et al.
2007/0273751 A1 11/2007 Sachau
2007/0291109 A1 12/2007 Wang et al.
2007/0291128 A1 12/2007 Wang et al.
2008/0009969 A1 1/2008 Bruemmer et al.
2008/0011904 A1 1/2008 Cepollina et al.
2008/0045804 A1 2/2008 Williams
2008/0065268 A1 3/2008 Wang et al.
2008/0082211 A1 4/2008 Wang et al.
2008/0126132 A1 5/2008 Warner et al.
2008/0133052 A1 6/2008 Jones et al.
2008/0174570 A1 7/2008 Jobs et al.
2008/0201016 A1 8/2008 Finlay
2008/0201017 A1 8/2008 Wang et al.
2008/0215987 A1 9/2008 Alexander et al.
2008/0229531 A1 9/2008 Takida
2008/0255703 A1 10/2008 Wang et al.
2008/0263451 A1 10/2008 Portele et al.
2008/0269949 A1 10/2008 Norman et al.
2008/0281467 A1 11/2008 Pinter
2008/0306375 A1 12/2008 Sayler et al.
2009/0030552 A1 1/2009 Nakadai et al.
2009/0044334 A1 2/2009 Parsell et al.
2009/0055023 A1 2/2009 Walters et al.
2009/0070135 A1 3/2009 Parida et al.
2009/0086013 A1 4/2009 Thapa
2009/0105882 A1 4/2009 Wang et al.
2009/0106679 A1 4/2009 Anzures et al.
2009/0122699 A1 5/2009 Alperovitch et al.
2009/0125147 A1 5/2009 Wang et al.
2009/0144425 A1 6/2009 Marr et al.
2009/0164255 A1 6/2009 Menschik et al.
2009/0164657 A1 6/2009 Li et al.
2009/0171170 A1 7/2009 Li et al.
2009/0177323 A1 7/2009 Ziegler et al.
2009/0177641 A1 7/2009 Raghavan
2009/0237317 A1 9/2009 Rofougaran
2009/0240371 A1 9/2009 Wang et al.
2009/0248200 A1 10/2009 Root
2009/0259339 A1 10/2009 Wright et al.
2010/0010672 A1 1/2010 Wang et al.
2010/0010673 A1 1/2010 Wang et al.
2010/0019715 A1 1/2010 Roe et al.
2010/0051596 A1 3/2010 Diedrick et al.
2010/0063848 A1 3/2010 Kremer et al.
2010/0070079 A1 3/2010 Mangaser et al.
2010/0073490 A1 3/2010 Wang et al.
2010/0076600 A1 3/2010 Cross et al.
2010/0085874 A1 4/2010 Noy et al.
2010/0088232 A1 4/2010 Gale
2010/0115418 A1 5/2010 Wang et al.
2010/0116566 A1 5/2010 Ohm et al.
2010/0131103 A1 5/2010 Herzog et al.
2010/0145479 A1 6/2010 Griffiths
2010/0157825 A1 6/2010 Anderlind et al.
2010/0191375 A1 7/2010 Wright et al.
2010/0228249 A1 9/2010 Mohr et al.
2010/0268383 A1 10/2010 Wang et al.
2010/0323783 A1 12/2010 Nonaka et al.
2011/0050841 A1 3/2011 Wang et al.
2011/0071702 A1 3/2011 Wang et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2011/0172822	A1	7/2011	Ziegler et al.
2011/0187875	A1	8/2011	Sanchez et al.
2011/0190930	A1	8/2011	Hanrahan et al.
2011/0213210	A1	9/2011	Temby et al.
2011/0218674	A1	9/2011	Stuart et al.
2011/0245973	A1	10/2011	Wang et al.
2011/0292193	A1	12/2011	Wang et al.
2011/0301759	A1	12/2011	Wang et al.
2012/0023506	A1	1/2012	Maeckel et al.
2012/0036484	A1	2/2012	Zhang et al.
2012/0072023	A1	3/2012	Ota
2012/0072024	A1	3/2012	Wang et al.
2012/0092157	A1	4/2012	Tran
2012/0095352	A1	4/2012	Tran
2012/0191246	A1	7/2012	Roe et al.
2012/0191464	A1	7/2012	Stuart et al.

FOREIGN PATENT DOCUMENTS

CN	1554193	A	12/2004
CN	1554985	A	12/2004
CN	101106939	A	1/2008
CN	101390098	A	3/2009
CN	101507260	A	8/2009
CN	101730894	A	6/2010
CN	101866396	A	10/2010
CN	101978365	A	2/2011
CN	102203759	A	9/2011
CN	101106939	B	11/2011
EP	466492	A2	1/1992
EP	488673	A2	6/1992
EP	0981905	B1	1/2002
EP	1 262 142	A2	12/2002
EP	1304872	A1	4/2003
EP	1 536 660	B2	9/2004
EP	1 536 660	A2	6/2005
EP	1573406	A2	9/2005
EP	1594660	A2	11/2005
EP	1763243	A2	3/2007
EP	1791464	A2	6/2007
EP	1800476	A2	6/2007
EP	1819108	A2	8/2007
EP	1856644	A2	11/2007
EP	1536660	A3	4/2008
EP	1928310	A2	6/2008
EP	1232610	B1	1/2009
EP	2027716	A2	2/2009
EP	2145274	A1	1/2010
EP	2214111	A2	8/2010
EP	2263158	A2	12/2010
EP	2300930	A1	3/2011
EP	2342651	A1	7/2011
GB	2431261	A	4/2007
JP	07-194609	A	8/1995
JP	2007-213753	A	8/1995
JP	2007-248823	A	8/1995
JP	07-257422	A	10/1995
JP	08-084328	A	3/1996
JP	8320727	A	12/1996
JP	9-267276	A	10/1997
JP	1079097	A	3/1998
JP	10288689	A	10/1998
JP	2000-032319	A	1/2000
JP	2000049800	A	2/2000
JP	2000079587	A	3/2000
JP	2000196876	A	7/2000
JP	2000-235423	A	8/2000
JP	2001-147718	A	5/2001
JP	2001125641	A	5/2001
JP	2001-198865	A	7/2001
JP	2001 198868	A	7/2001
JP	2001-199356	A	7/2001
JP	2001179663	A	7/2001
JP	2000-188124		1/2002
JP	2002-000574	A	1/2002
JP	2002-046088	A	2/2002
JP	2002101333	A	4/2002
JP	2002112970	A	4/2002
JP	2002-305743	A	10/2002
JP	2002-355779	A	12/2002
JP	2004524824	T	8/2004
JP	2004261941	A	9/2004
JP	2004289379	A	10/2004
JP	2005028066	A	2/2005
JP	2005059170	A	3/2005
JP	2006508806	A	3/2006
JP	2006109094	A	4/2006
JP	2006224294	A	8/2006
JP	2006246438	A	9/2006
JP	2007007040	A	1/2007
JP	2007081646	A	3/2007
JP	2007232208	A	9/2007
JP	2007316966	A	12/2007
JP	2010064154	A	3/2010
JP	2010532109	A	9/2010
JP	2010246954	A	11/2010
KR	20060037979	A	5/2006
KR	20090012542	A	2/2009
KR	20100019479	A	2/2010
KR	20100139037	A	12/2010
WO	WO 93/06690	A1	4/1993
WO	WO 98/51078	A	11/1998
WO	WO 99/67067	A1	12/1999
WO	00/25516	A1	5/2000
WO	00/33726	A1	6/2000
WO	01/31861	A1	5/2001
WO	WO 03/077745	A	9/2003
WO	2004/008738	A1	1/2004
WO	2004/012018	A2	2/2004
WO	WO 2004/075456	A2	9/2004
WO	2006/012797	A1	2/2006
WO	2006/044847	A2	4/2006
WO	2006/078611	A2	7/2006
WO	2007/041295	A2	4/2007
WO	WO 2007/041295	A1	4/2007
WO	2007/041038	A3	6/2007
WO	2008/100272	A2	8/2008
WO	2008/100272	A3	10/2008
WO	2009/117274	A2	9/2009
WO	2009/128997	A1	10/2009
WO	2009/145958	A2	12/2009
WO	2010/006205	A1	1/2010
WO	2010/006211	A1	1/2010
WO	2010/033666	A1	3/2010
WO	2010/047881	A1	4/2010
WO	2010/062798	A1	6/2010
WO	2010/065257	A1	6/2010
WO	2010/120407	A1	10/2010
WO	2011/028589	A2	3/2011
WO	2011/028589	A3	4/2011
WO	2011/097130	A2	8/2011
WO	2011/097132	A2	8/2011
WO	2011/109336	A2	9/2011
WO	2011/097132	A3	12/2011
WO	2011/149902	A2	12/2011

OTHER PUBLICATIONS

Han, et al., "Construction of an Omnidirectional Mobile Robot Platform Based on Active Dual-Wheel Caster Mechanisms and Development of a Control Simulator", 2000, Kluwer Acedemic Publishers, vol. 29, pp. 257-275.

Haule et al., "Control Scheme for Delayed Teleoperation Tasks", May 17, 1995, Proceedings of the Pacific Rim Conference on Communications, Computer and Signal Processing.

Lee et al., "A novel method of surgical instruction: International telementoring", 1998, Internet pp. 1-4.

Linebarger, John M. et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Presence, Special Issue on Advances in Collaborative VEs (2004).

(56) **References Cited**

OTHER PUBLICATIONS

Ogata et al., "Emotional Communication Robot: WAMOEBA-2R—Emotion Model and Evaluation Experiments", 1999, Internet, pp. 1-16.

Rovetta et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and Optical Fiber Networks for Data Exchange", Jun. 1, 1996, International Journal of Robotics Research, pp. 267-279.

Al-Kassab, "A Review of Telemedicine", Journal of Telemedicine and Telecare, 1999, vol. 5, Supplement 1.

F. Ando et al., "A Multimedia Self-service Terminal with Conferencing Functions", 1995, IEEE, pp. 357-362.

Android Amusement Corp., "What Marketing Secret", 1982 http:///www.theoldrobots.com/images17/dc8.JPG.

Applebome, "Planning Domesticated Robots for Tomorrow's Household", New York Times, Mar. 4, 1982, pp. 21 and 23 http://www.theoldrobots.com/images17/dc17.JPG.

Baltus et al., "Towards Personal Service Robots for the Elderly, Proceedings for the Elderly Workshop on Interactive Robots and Entertainment", 2000, Computer Science and Robotics, http://www.cs.cmu.edu/thrun/papers/thrun.nursebot-early.pdf.

Bar-Cohen et al., Virtual reality robotic telesurgery simulations using MEMICA haptic system, Mar. 5, 2001, Internet, pp. 1-7.

Bartholomew, "An Apothecary's Pharmacy", 1230-1240 http://classes.bnf.fr/ema/grands/034.htm.

Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", Jun. 2003.

Bauer, John et al., "Remote telesurgical mentoring: feasibility and efficacy", 2000, IEEE, pp. 1-9.

Bischoff, "Design Concept and Realization of the Humanoid Service Robot HERMES", Field and Service Robotics, Springer, London, 1998, pp. 485-492.

Blackwell, Gerry, "Video: A Wireless LAN Killer App?", 2002, Internet pp. 1-3.

Breslow, Michael J., MD et al., "Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcome: An alternative paradigm for intensivist staffing", Critical Care Med, Jan. 2004, vol. 32, No. 1, pp. 31-38.

Brooks, Rodney, Abstracts from Flesh & Machines, How Robots Will Change Us, "Remote Presence", p. 131-147, Feb. 2002.

Candelas Herias, F.A. et al., "Flexible virtual and remote laboratory for teaching Robotics", FORMATEX 2006, Proc. Advance in Control Education, Madrid, Spain, Jun. 21-23, 2006.

Celi et al., "The eICU: It's not just telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001.

Cheetham, Anastasia et al., "Interface Development for a Child's Video Conferencing Robot", 2000, pp. 1-4.

Cleary et al., "State of the art in surgical robotics: Clinical applications and technology challenges", Feb. 24, 2002 Internet, pp. 1-26.

CNN, "Floating 'droids' to roam space corridors of the future", Jan. 12, 2000, Internet, pp. 1-4.

CNN.com/Technology,"Paging R.Robot: Machine helps doctors with patients", Sep. 30, 2003, Internet, 1-3.

Crowley, "Hello to Our Future", AARP Bulletin, Jan. 2000 http://www.cs.cmu.ed/-nursebot/web/press/aarp_99_14/millennium.html.

Dalton, "Techniques for Web Telerobotics", PhD thesis, University of Western Australia, 2001, http://telerobot.mech.uwa.edu.au/information.html, http://catalogue.library.uwa.edu.au/search.

Davies, "Robotics in Minimally Invasive Surgery", 1995, Internet, pp. 5/1-5/2.

Digiorgio, James, "Is Your Emergency Department of the 'Leading Edge'?", 2005, Internet, pp. 1-4.

Discovery Channel Canada, "Inventing the Future: 2000 Years of Discovery", Jan. 2, 2000 (Video/Transcript).

Elhajj et al., "Supermedia in Internet-based telerobotic operations", 2001, Internet, pp. 1-14.

Elhajj et al., "Synchronization and Control of Supermedia Transmission Via the Internet", Proceedings of 2001 International Symposium on Intelligent Multimedia, Video and Speech Processing, May 2-4, 2001, Hong Kong.

Ellison et al., "Telerounding and Patient Satisfaction Following Surgery".

Fels, "Developing a Video-Mediated Communication System for Hospitalized Children", Telemedicine Journal, vol. 5, No. 2, 1999.

Fetterman, Videoconferencing over the Internet, 2001, Internet, pp. 1-8.

Fiorini, "Health Care Robotics: A Progress Report, IEEE International Conference on Robotics and Automation", 1997.

Ghiasi, "A Generic Web-based Teleoperations Architecture: Details and Experience", SPIE Conference on Telemanipulator and Telepresence Technologies VI, Sep. 1999.

Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation, Apr. 2000, San Francisco, California.

Goldberg, "Desktop Teloperation via the World Wide Web, Proceedings of the IEEE International Conference on Robotics and Automation", 1995, http://citeseer.ist.psu.edu/cache/papers/cs/5/ftp:zSzzSzusc.eduzSzpubzSziriszSzraiders.pdf/gol.

Goldberg, "More Online Robots, Robots that Manipulate", Internet, Updated Aug. 2001 http://ford.ieor.berkeley.edu/ir/robots_a2.html.

Goldman, Lea, "Machine Dreams", Entrepreneurs, Forbes, May 27, 2002.

Gump, Michael D., "Robot Technology Improves VA Pharmacies", 2001, Internet, pp. 1-3.

Handley, "RFC 2327—SDP: Session Description Protocol", Apr. 1998 http://www.faqs.org/rfcs/rfc2327.html.

Hanebeck, "ROMAN: a mobile Robotic Assistant for Indoor Service Applications", Proceedings of the 1997 IEEE/RSJ International Conference on Intelligent Robots and Systems, 1997.

Harmo et al., "Moving Eye—Interactive Telepresence Over Internet With a Ball Shaped Mobile Robot", 2000.

Hees, William P., "Communications Design for a Remote Presence Robot", Jan. 14, 2002.

Holmberg, "Development of a Holonomic Mobile Robot for Mobile Manipulation Tasks", International Conference on Field and Service Robotics, Pittsburgh, PA, Aug. 1999.

Ishiguro, "Integrating a Perceptual Information Infrastructure with Robotic Avatars: A Framework for Tele-Existence" Proceeding of IEEE Conference on Intelligent Robots and Systems, http://www.ai.soc.i.kyoto-u.ac.jp/services/publications/99/99conf/07.pdf.

Ishihara, Ken et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Nov. 3-5, 1991, IEEE/RSJ, pp. 1145-1150, vol. 2.

ITU, "ITU-T H.323 Packet-based multimedia communications", ITU, Feb. 1998, http://www.itu.int/rec/T-REC-H.323-199802-S/en.

Ivanova, Natali, "Master's thesis: Internet Based Interface for Control of a Mobile Robot", Department of Numerical Analysis and Computer Science.

Jenkins, "Telehealth Advancing Nursing Practice", Nursing Outlook, Mar./Apr. 2001, vol. 49, No. 2.

Johanson, Supporting video-mediated communication over the Internet, Chalmers University of Technology, Dept of Computer Engineering, Gothenburg, Sweden, 2003.

Jouppi, et al., "Mutually-Immersive Audio Telepresence", Audio Engineering Society Convention Paper, presented at 113th Convention Oct. 2002.

Jouppi, Norman P., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Nov. 16-20, 2002, New Orleans LA.

Kanehiro, Fumio et al., Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting, 2001, IEEE, pp. 3217-3276.

Kaplan et al., "An Internet Accessible Telepresence".

Keller et al., "Raven Interface Project", Fall 2001 http://upclose.lrdc.pitt.edu/people/louw_assets/Raven_Slides.pps.

Khatib, "Robots in Human Environments", Proc. International Conference on Control, Automation, Robotics, and Vision, ICRACV2000, Dec. 2000, Singapore, pp. 454-457.

Kuzuoka et al., "Can the GestureCam Be a Surrogate?".

(56) **References Cited**

OTHER PUBLICATIONS

Lane, "Automated Aides", Newsday, Oct. 17, 2000, http://www.cs.cum.edu/-nursebot/web/press/nd4380.htm.
Lim, Hun-ok et al., Control to Realize Human-like Walking of a Biped Humanoid Robot, IEEE 2000, pp. 3271-3276.
Loeb, Gerald, "Virtual Visit: Improving Communication for Those Who Need It Most", 2001.
Long, "HelpMate Robotics, Inc. (Formerly Transitions Research Corporation) Robot Navigation Technology", NIST Special Publication 950-1, Mar. 1999, http://www.atp.nist.gov/eao/sp950-1/helpmate.htm.
Luna, Nancy, "Robot a new face on geriatric care", OC Register, Aug. 6, 2003.
Mack, "Minimally invasive and robotic surgery", 2001, Internet IEEE, pp. 568-572.
Mair, Telepresence—The Technology and Its Economic and Social Implications, IEEE Technology and Society, 1997.
Martin, Anya, "Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.
McCardle et al., "The challenge of utilizing new technology in design education", 2000 Internet, pp. 122-127.
Meng, "E-Service Robot in Home Healthcare", Proceedings of the 2000, IEEE/RSJ, International Conference on Intelligent Robots and Systems, 2000.
Michaud, Introducing 'Nursebot', The Boston Globe, Sep. 11, 2001, pp. 1-5, http://www.cs.cmu.edu/nursebot/web/press/globe_3_01/index.html.
Mobile Robotics Research Group, "Mobile Robotics Research Group", 2000 Internet, pp. 1-2, Edinburgh.
Montemerlo, "Telepresence: Experiments in Next Generation Internet", CMU Robotics Institute, Oct. 20, 1998, http://www.ri.cmu.edu/creative/archives.htm (Video/Transcript).
Murphy, "Introduction to A1 Robotics", 2000.
Nakajima et al., "A Multimedia Teleteaching System sing an Electronic Whiteboard for Two-Way Communication of Motion Videos and Chalkboards", 1993, IEEE, pp. 436-441.
"National Energy Research Scientific Computing Center, Berkeley Lab's RAGE Telepresence Robot Captures R&D100 Award", Jul. 2, 2002, http://www.nersc.gov/news/newsroom/RAGE070202.php.
Nomadic Technologies, Inc., "Nomad XR4000 Hardware Manual", Mar. 1999.
Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2r—Esperimental evaluation . . . ", 2000 IEEE, pp. 175-180.
Oh, "Autonomous Battery Recharging for Indoor Mobile Robots", Proceedings of Australian Conference on Robotics and Automation, 2000, http://users.rsise.anu.edu.au/rsl/rsl_papers/ACRA2000/Auto_Recharge_Paper.pdf.
Ojha, Anad, "An application of Virtual Reality in Rehabilitation", Jan. 1994, IEEE, pp. 4-6.
Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", http://vive.cs.berkeley.edu/capek, 1995.
Paulos, "Designing Personal Tele-embodiment", IEEE International Conference on Robotics and Automation, 1998, http://www.prop.org/papers/icra98.pdf.
Paulos, Eric John, "Personal Tele-Embodiment", UC Berkeley, Fall 2001.
Paulos, "PRoP: Personal Roving Presence", ACM:CHI Proceedings of CHI '98, http://www.prop.org/papers/chi98.pdf.
Paulos, Video of PRoP 2 at Richmond Field Station, www.prop.org. May 2001, Printout of Home Page of Website and two-page Transcript of the audio portion of said PRoP Video.
Paulos, et al. , "Ubiquitous Tele-embodiment: Applications and Implications", International Journal of Human Computer Studies, Jun. 1997, vol. 46, No. 6, pp. 861-877.
Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE, vol. 10, No. 4, Aug. 1994.
Roy et al., "Towards Personal Service Robots for the Elderly", Internet, Mar. 7, 2002.
Salemi et al, "MILO: Personal robot platform", 2005, Internet, pp. 1-6.
Sandt, Frederic et al., "Perceptions for a Transport Robot in Public Environments", 1997, IROS '97.
Schaeffer, "Care-O-bot: A System for Assisting Elderly or Disabled Persons in Home Environments", Proceedings of AAATE-99, 1999, http://morpha.de/download/publications/IPA_Systems_For_AssistingElderly_or_DisabledPersons_AAATE1999.pdf.
Schultz, "Web Interfaces for Mobile Robots in Public Places", Robotics & Automation magazine, IEEE, vol. 7, Issue 1, Mar. 2000.
Shimoga et al., Touch and force reflection for telepresence surgery, 1994, IEEE, pp. 1049-1050.
Siegwart, "Interacting Mobile Robots on the Web", Proceedings of the 1999 IEEE International Conference on Robotics and Automation, May 1999.
Simmons, "Xavier: An Autonomous Mobile Robot on the Web", IEE robotics and Automation Magazine, 1999, pp. 43-48.
Spawar Systems Center, "Robart", 1998, San Diego, CA, http://web.archive.org/web/*/http://www.nosc.mil/robots/land/robart/robart.html http://web.archive.org/web/19981202205636/http://www.nosc.mil/robots/land/robart/robart.html.
Stephenson, Gary, "Dr. Robot Tested at Hopkins", Aug. 5, 2003, Internet, pp. 1-2.
Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Dec. 2002, Internet, 1-17.
Suplee, "Mastering the Robot", The Washington Post, p. A01, Sep. 17, 2000 http://www.cs.cmu.edu-nursebot/web/press/wash/index.html.
Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", 1997, IEEE, pp. 2771-2776.
Thrun et al, "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", 2000, Internet pp. 1-35.
Tzafestas, et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", 2000, Internet, pp. 1-23.
Urquhart, Kim, "InTouch's robotic Companion 'beams up' healthcare experts", Medical Device Daily, vol. 7, No. 39, Feb. 27, 2003, p. 1, 4.
Weiss et al., Telework and video-mediated communication: Importance of real-time, interactive communication for workers with disabilities, pp. 1-4, California State University Northridge, http://www.csun.edu/cod/conf/1999/proceedings/session0238.html.
West et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design, vol. 119, pp. 153-161, Jun. 1997.
Yamasaki et al., Applying Personal Robots and Active Interface to Video Conference Systems, 1995, Internet, pp. 243-248.
Yong et al., "Robot task execution with telepresence using virtual reality technology", 1998, Internet, pp. 1-9.
Zamrazil, Kristie, "Telemedicine in Texas: Public Policy Concerns", House Research Organization Focus Report, Texas House of Representatives, No. 76-22, May 5, 2000 http://www.hro.house.state.tx.us/focus/telemed.pdf.
Zipperer, Lorri, "Robotic dispensing system", 1999, Internet, pp. 1-2.
Zorn, Benjamin G., "Ubiquitous Telepresence", http://www.cs.colorado.edu/~zorn/ut/vision/vision.html, Mar. 5, 1996.
Noritsugu et al., "Application of Rubber Artificial Muscle Manipulator as a Rehabilitation Robot", Mechatronics, IEEE/ASME Transactions, vol. 2, No. 4, Dec. 1997, pp. 259-267.
North, Michael, "Telemedicine: Sample Script and Specifications for a Demonstration of Simple Medical Diagnosis and Treatment Using Live Two-Way Video on a Computer Network", Greenstar Corporation, 1998, 5 pages.
Picturetel Corporation, "Introducing PictureTel Live200 for Windows NT", 1997, 63 pages.
Piquepaille, Roland, "How New Technologies are Modifying Our Way of Life", Roland Piquepaille's Technology Trends, This Blog and its RSS Feed Are Moving, Oct. 31, 2004, 2 pages.
Radvision, "Making Sense of Bandwidth the NetSense Way", Network Congestion in Unmanaged Networks Bandwidth Estimation and Adaptation Techniques, Radvision's Netsense Technology, 2010, 7 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Reynolds et al., "Review of Robotic Telemedicine Utilization in Intensive Care Units (ICUs)", 11th Annual ATA Symposium, Tampa, Florida, 2011, 1 page.
Roach, Adam, "Automatic Call Back Service in SIP", Internet Engineering Task Force, Internet Draft, Category: Informational, Mar. 2000, 8 pages.
Roy et al., "Towards Personal Service Robots for the Elderly", Workshop on Interactive Robots and Entertainment (WIRE 2000), vol. 25, Apr. 30-May 1, 2000, 7 pages.
Tahboub et al., "Dynamics Analysis and Control of a Holonomic Vehicle With Continously Variable Transmission", Journal of Dynamic Systems, Measurement and Control ASME, vol. 124, Mar. 2002, pp. 118-126.
Telepresence Research, Inc., "Telepresence Mobile Robot System", available online at <http://www.telepresence.com/telepresence-research/TELEROBOT/>, retrieved on Nov. 23, 2010, Feb. 20, 1995, 3 pages.
Theodosiou et al., "MuLVAT: A Video Annotation Tool Based on XML-Dictionaries and Shot Clustering", 19th International Conference, Artificial Neural Networks—ICANN, Sep. 14-17, 2009, pp. 913-922.
Time, Lists, "Office Coworker Robot", Best Inventions of 2001, available online at <http://content.time.com/time/specials/packages/article/0,28804,1936165_1936255_1936640,00.html>, Nov. 19, 2001, 2 pages.
Tipsuwan et al., "Gain Adaptation of Networked Mobile Robot to Compensate QoS Deterioration", vol. 4, 28th Annual Conference of the Industrial Electronics Society, Nov. 5-8, 2002, pp. 3146-3151.
Tsui et al., "Exploring Use Cases for Telepresence Robots", 6th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Mar. 2011, 7 pages.
Tyrrell et al., "Teleconsultation in Psychology: The Use of Videolinks for Interviewing and Assessing Elderly Patients", British Geriatrics Society, Age and Ageing, vol. 30, No. 3, May 2001, pp. 191-195.
Umass Lowell Robotics Lab, "Robotics Lab @ UMASS Lowell", Department of Computer Science, Brochure, 2011, 2 pages.
Weaver et al., "Monitoring and Controling Using the Internet and Java", Proceedings of the 25th Annual Conference of the IEEE Industrial Electronics Society, vol. 3, 1999, pp. 1152-1158.
Weiss, et al., "PEBBLES: A Personal Technology for Meeting Education, Social and Emotional Needs of Hospitalised Children", Personal and Ubiquitous Computing, vol. 5, No. 3, Aug. 2001, pp. 157-168.
West et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design, ASME, vol. 119, Jun. 1997, pp. 153-161.
Yamauchi, Brian, "PackBot: A Versatile Platform for Military Robotics", Proceedings of SPIE for Military Robotics, 2004, pp. 228-237.
Zambroski, James, "CMU, Pitt Developing 'Nursebot'", available online at <http://www.cs.cmu.edu/~nursebot/web/press/tribunereview.html>, retrieved on Jun. 26, 2012, Oct. 27, 2000, 3 pages.
U.S. Appl. No. 10/783,760, Feb. 20, 2004, 48 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US2006/037076, Apr. 1, 2008, 6 pages.
International Search Report and Written Opinion Received for International Application No. PCT/US2006/037076, May 11, 2007, 6 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US/2007/14099, Dec. 16, 2008, 5 pages.
International Search Report Received for international Patent Application No. PCT/US2007/14099, Jul. 30, 2008, 1 page.
International Search Report Received for International Patent Application No. PCT/US2005/037347, Apr. 17, 2006, 2 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US2005/037347, Apr. 17, 2006, 7 pages.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. I of IV, Jun. 24, 2013, pp. A1-A6357.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. II of IV, Jun. 24, 2013, pp. A6849-A10634.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. III of IV, Jun. 24, 2013, pp. A10654-A15517.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. IV of IV, Jun. 24, 2013, pp. A15677-A18127.
Reply Brief for Defendant-Appellee VGO Communications, Inc., Appeal from the U.S. District Court for the Central District of California, in Case No. 2:11-cv-9185, Judge Percy Anderson, May 28, 2013, 75 pages.
Civil Minutes—General: Case No. CV 11-9185PA (AJWx), *InTouch Tech., Inc.* v. *VGo Commons, Inc.*, U.S. District Court for the Central District of California, Judge Percy Anderson, Sep. 10, 2012, 7 pages.
Defendant VGo Communications, Inc.'s Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order, U.S. District Court for the Central District of California, in Case No. CV11-9185 PA, May 2, 2012, 143 pages.
Defendant-Counterclaimant VGo Communications, Inc.'s Supplemental Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order, U.S. District Court for the Central District of California, Case No. CV11-9185 PA, May 14, 2012, 228 pages.
"Magne Charge", Smart Power for Electric Vehicles, General Motors Corporation, Serial No. 75189637, Registration No. 2114006, Filing Date: Oct. 29, 1996, Aug. 26, 1997, 2 pages.
Opening Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Apr. 12, 2013, 187 pages.
"PictureTel Adds New Features and Functionality to its Award-Winning Live200 Desktop Videoconferencing System", PR Newswire Association, LLC, Gale, Cengage Learning, Jun. 13, 1997, 4 pages.
Reply Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Jun. 14, 2013, 39 pages.
"Using your Infrared Cell Phone Camera", available online on <http://www.catsdomain.com/xray/about.htm>, retrieved on Jan. 23, 2014, Courtesy of Internet Wayback Machine, Jan. 30, 2010, 4 pages.
Office Action received for Chinese Patent Application No. 200680044698.0 on Nov. 4, 2010. (9 pages of Official Copy and 17 pages of English Translation).
Wang et al., "A Healthcare Tele-robotic System with a Master Remote Station with an Arbitrator", U.S. Appl. No. 60/449,762, filed Feb. 24, 2003, 28 pages.
Active Media, Inc., "Saphira Software Manual", Real World, Saphira Version 5.3, 1997, 105 pages.
Activmedia Robotics LLC, "Pioneer 2/PeopleBot™", Operations Manual, Version 9, Oct. 2001, 78 pages.
Adams, Chris, "Simulation of Adaptive Behavior (SAB'02)—From Animals to Animats 7", Mobile Robotics Research Group, The Seventh International Conference, available online at: <http://www.dai.ed.ac.uk/groups/mrg/MRG.html>, retrieved on Jan. 22, 2014, Aug. 4-11, 2002, 1 page.
Apple Inc., "I Phone", iPhone Series, XP002696350, Sep. 21, 2012, pp. 1-29.
Barrett, Rick, "Video Conferencing Business Soars as Companies Cut Travel; Some Travel Cuts are Permanent", available online at <http://www.ivci.com/international_videoconferencing_news_videoconferencing_news_19.html>, May 13, 2002, 2 pages.
Blaer et al., "TopBot: Automated Network Topology Detection With a Mobile Robot", IEEE, Proceedings of the 2003 International Conference on Robotics and Automation, Taipei, Taiwan, Sep. 14-19, 2003, pp. 1582-1587.
Bradner, S., "The Internet Standards Process—Revision 3", Network Working Group, Request for Comments: 2026, BCP: 9, Obsoletes: 1602, Category: Best Current Practice, Oct. 1996, pp. 1-36.

(56) **References Cited**

OTHER PUBLICATIONS

Brooks, Rodney A., "A Robust Layered Control System for a Mobile Robot", IEEE, Journal of Robotics and Automation, vol. 2, No. 1, Mar. 1986, pp. 14-23.

Brooks, Rodney Allen, "Flesh and Machines: How Robots Will Change Us", available online at <http://dl.acm.org/citation.cfm?id=560264&preflayout=flat%25202%2520of>, retrieved on Nov. 23, 2010, Feb. 2002, 3 pages.

Christensen et al., "BeeSoft User's Guide and Reference", Robots for the Real World™, Real World Interface, Inc ., Sep. 26, 1997, 203 pages.

Chu et al., "Detection of Target Mobile Signal Strength", Technical Development, Motorola Inc., Jan. 1999, pp. 205-206.

Dario et al., "A Robot Workstation for Diagnosis and Physical Therapy", IEEE Catalog No. 88TH0234-5, Centro "E. Piaggio" University of Pisa, Italy, 1989, pp. 67-72.

Davis, Erik, "Telefriend, Meet iRobot, The Smartest Webcam on Wheels", Wired Magazine, Issue 8.09, available online at <http://www.wired.com/wired/archive/8.09/irobot.html?pg=1&topic=&topic_set=>, retrieved on Jul. 7, 2012, Sep. 2000, 3 pages.

Dean et al., "1992 AAAI Robot Exhibition and Competition", Articles, AI Magazine, vol. 14, No. 1, 1993, 15 pages.

Dudenhoeffer et al., "Command and Control Architectures for Autonomous Micro-Robotic Forces", FY00 Project Report, Idaho National Engineering and Environmental Laboratory, Human Systems Engineering and Sciences Department, Idaho Falls, Apr. 2001, 43 pages.

Elhajj et al., "Real-Time Haptic Feedback in Internet-Based Telerobotic Operation", IEEE International Conference on Electro/Information Technology, Jun. 2000, 10 pages.

Evans et al., "HelpMate: The Trackless Robotic Courier", PYXIS, available online at <http://www.pyxis.com/>, 3 pages.

Fiorini et al., "Health Care Robotics: A Progress Report", IEEE International Conference on Robotics and Automation, vol. 2, Apr. 20-25, 1997, pp. 1271-1276.

Fong, Terrence, "Collaborative Control: A Robot-Centric Model for Vehicle Teleoperation", The Robotics Institute Carnegie Mellon University, Nov. 2001, 197 pages.

Gaidioz et al., "Synchronizing Network Probes to Avoid Measurement Intrusiveness with the Network Weather Service", High-Performance Distributed Computing, Proceedings of the Ninth International Symposium, 2000, pp. 147-154.

Garner et al., "The Application of Telepresence in Medicine", BT Technology Journal, vol. 15, No. 4, Oct. 1, 1997, pp. 181-187.

ITU, "Call Completion Supplementary Services for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.9, Series H: Audiovisual and Multimedia Systems, Nov. 2000, 63 pages.

ITU, "Call Intrusion Supplementary Service for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.11, Series H: Audiovisual and Multimedia Systems, Mar. 2001, 59 pages.

ITU, "A Far End Camera Control Protocol for Videoconferences Using H.224", Transmission of Non-Telephone Signals, ITU-T, Telecommunication Standardization Sector of ITU, H.281, Nov. 1994, 12 pages.

Jacobs et al., "Applying Telemedicine to Outpatient Physical Therapy", AMIA, Annual Symposium Proceedings, 2002, 1 page.

Knight et al., "Active Visual Alignment of a Mobile Stereo Camera Platform", Robotics and Automation, Proceedings of ICRA '00, IEEE International Conference, vol. 4, Apr. 24-28, 2000, pp. 3203-3208.

Kurlowicz et al., "The Mini Mental State Examination (MMSE)", The Hartford Institute for Geriatric Nursing, Journal of Psychiatric Research, No. 3, Jan. 1999, 2 pages.

Leifer et al., "VIPRR: A Virtually in Person Rehabilitation Robot", Proceedings of 1997 International Conference on Rehabilitation Robotics, Apr. 14-15, 1997, 4 pages.

Lemaire, Edward, "Using Communication Technology to Enhance Rehabilitation Services", Terry Fox Mobile Clinic, The Rehabilitation Centre, Ottawa, Canada, Version 2.0, 1998-2001, 104 pages.

Metz, Cade, "HP Labs", available online at <http://www.pcmag.com/article2/0,2817,1130820,00.asp>, Jul. 1, 2003, 4 pages.

Microsoft Corporation, Inc., "Microsoft NetMeeting 3 Features", available online at <http://technet.microsoft.com/en-us/library/cc723477.aspx>, retrieved on Jun. 26, 2012, 6 pages.

Minsky, Marvin, "Telepresence", OMNI Magazine, Jun. 1980, 6 pages.

Nakazato et al., "Group-Based Interface for Content-Based Image Retrieval", Proceedings of the Working Conference on Advanced Visual Interfaces, 2002, pp. 187-194.

Nakazato et al., "Group-Oriented User Interface for Digital Image Management", Journal of Visual Languages and Computing, vol. 14, No. 4, Aug. 2003, pp. 45-46.

* cited by examiner

FIG. 1

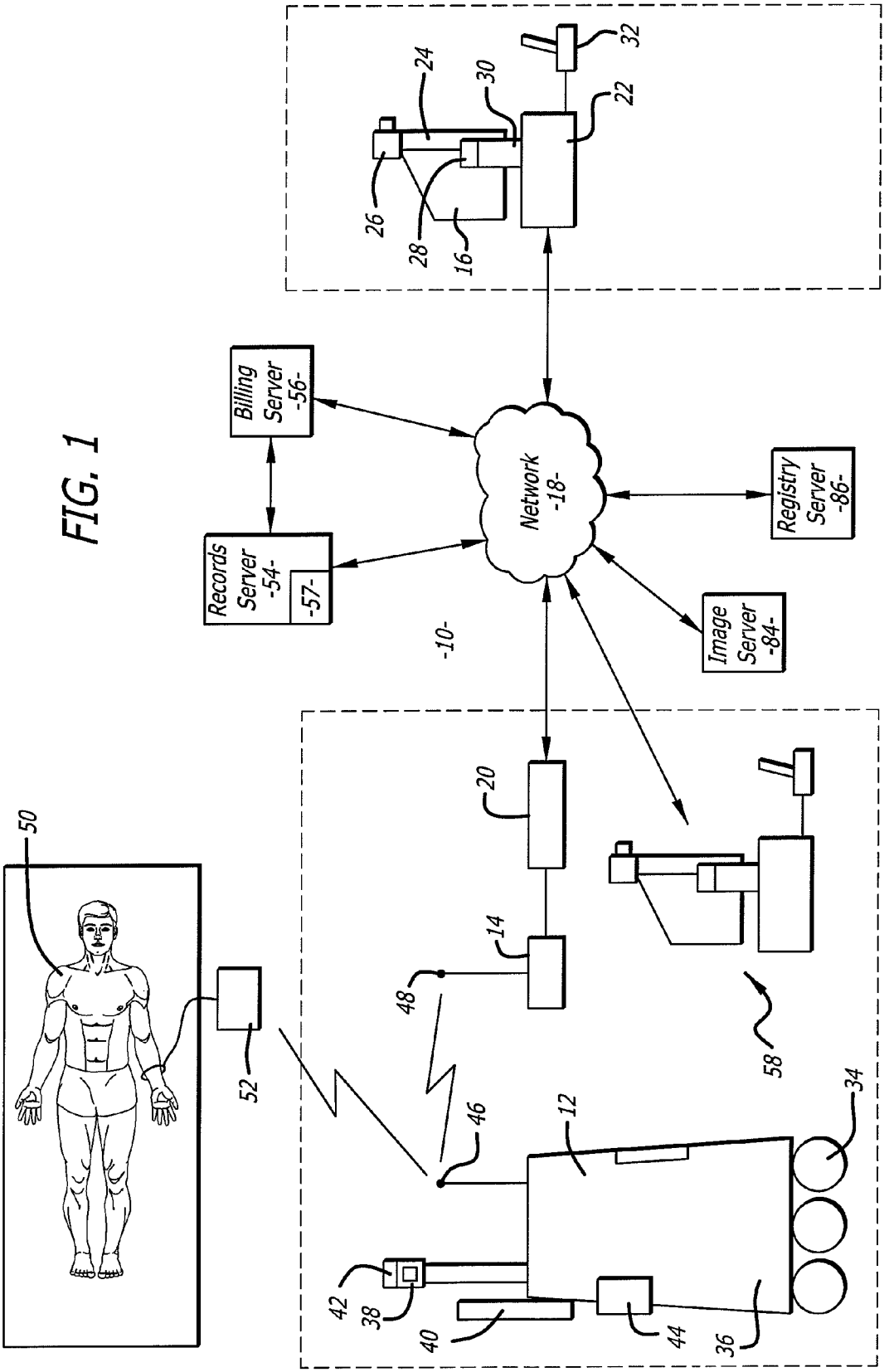

Billing Server -56-
Network -18-
Registry Server -86-
Records Server -54-
-57-
Image Server -84-
-10-
24
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FIG. 2

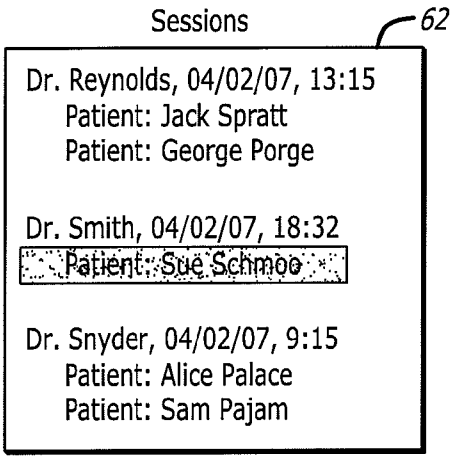


FIG. 3

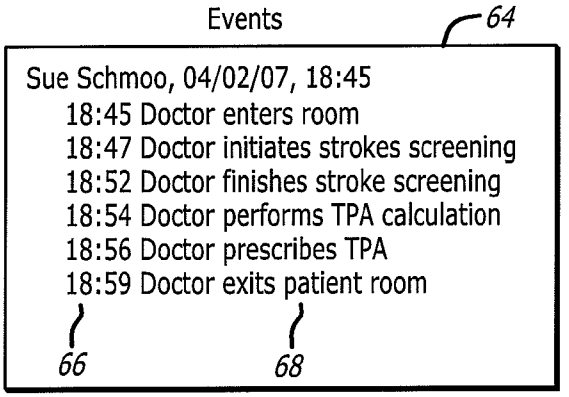


FIG. 4

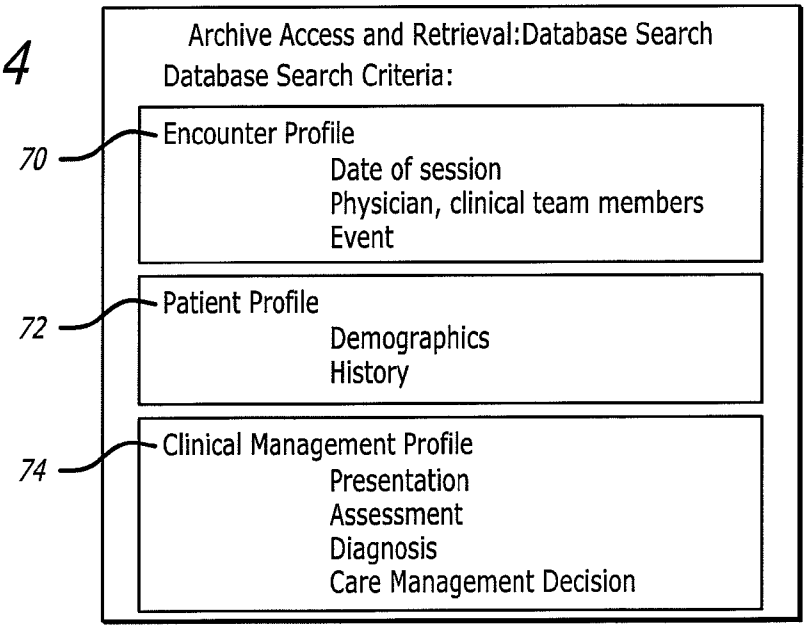


FIG. 5

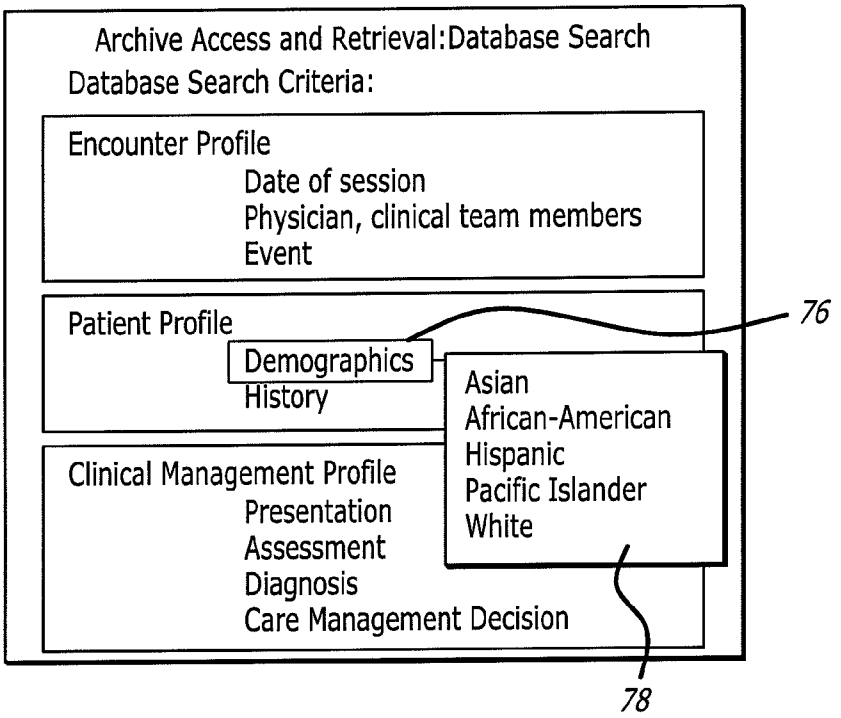
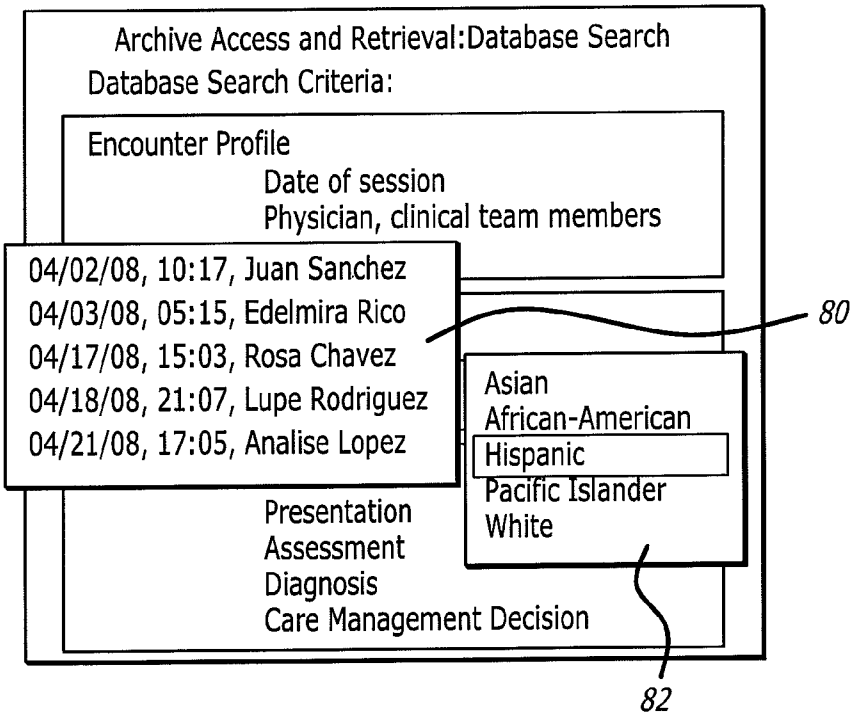

Archive Access and Retrieval:Database Search
Database Search Criteria:
Encounter Profile
Date of session
Physician, clinical team members
Event
Patient Profile
Demographics
History
Clinical Management Profile
Presentation
Assessment
Diagnosis
Care Management Decision
Asian
African-American
Hispanic
Pacific Islander
White
76
78

FIG. 6


Archive Access and Retrieval:Database Search
Database Search Criteria:
Encounter Profile
Date of session
Physician, clinical team members
04/02/08, 10:17, Juan Sanchez
04/03/08, 05:15, Edelmira Rico
04/17/08, 15:03, Rosa Chavez
04/18/08, 21:07, Lupe Rodriguez
04/21/08, 17:05, Analise Lopez
Presentation
Assessment
Diagnosis
Care Management Decision
Asian
African-American
Hispanic
Pacific Islander
White
80
82

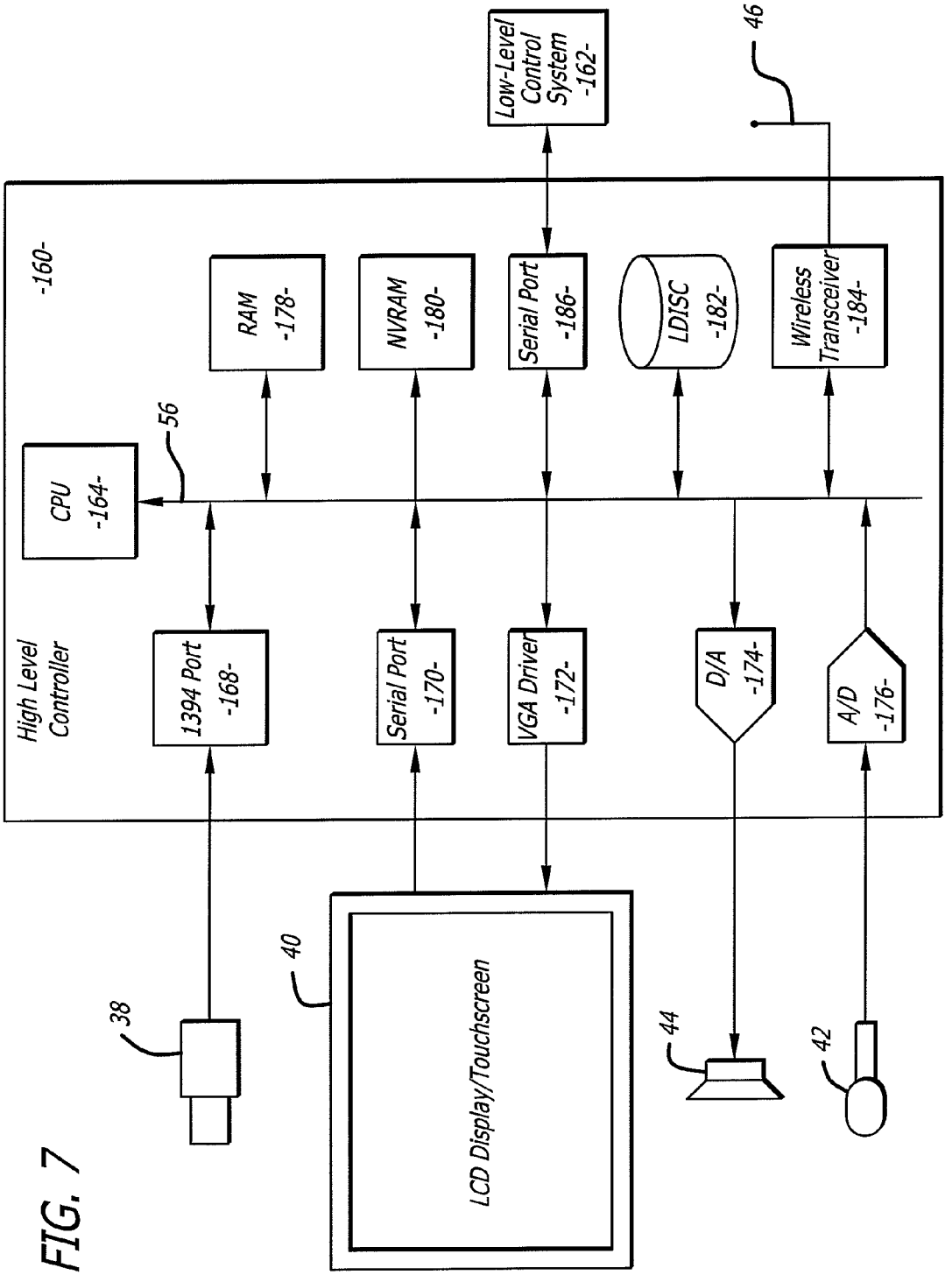

Low-Level Control System -162-
46
-160-
RAM -178-
NVRAM -180-
Serial Port -186-
LDISC -182-
Wireless Transceiver -184-
56
CPU -164-
High Level Controller
1394 Port -168-
Serial Port -170-
VGA Driver -172-
D/A -174-
A/D -176-
38
40
LCD Display/Touchscreen
44
42

FIG. 7

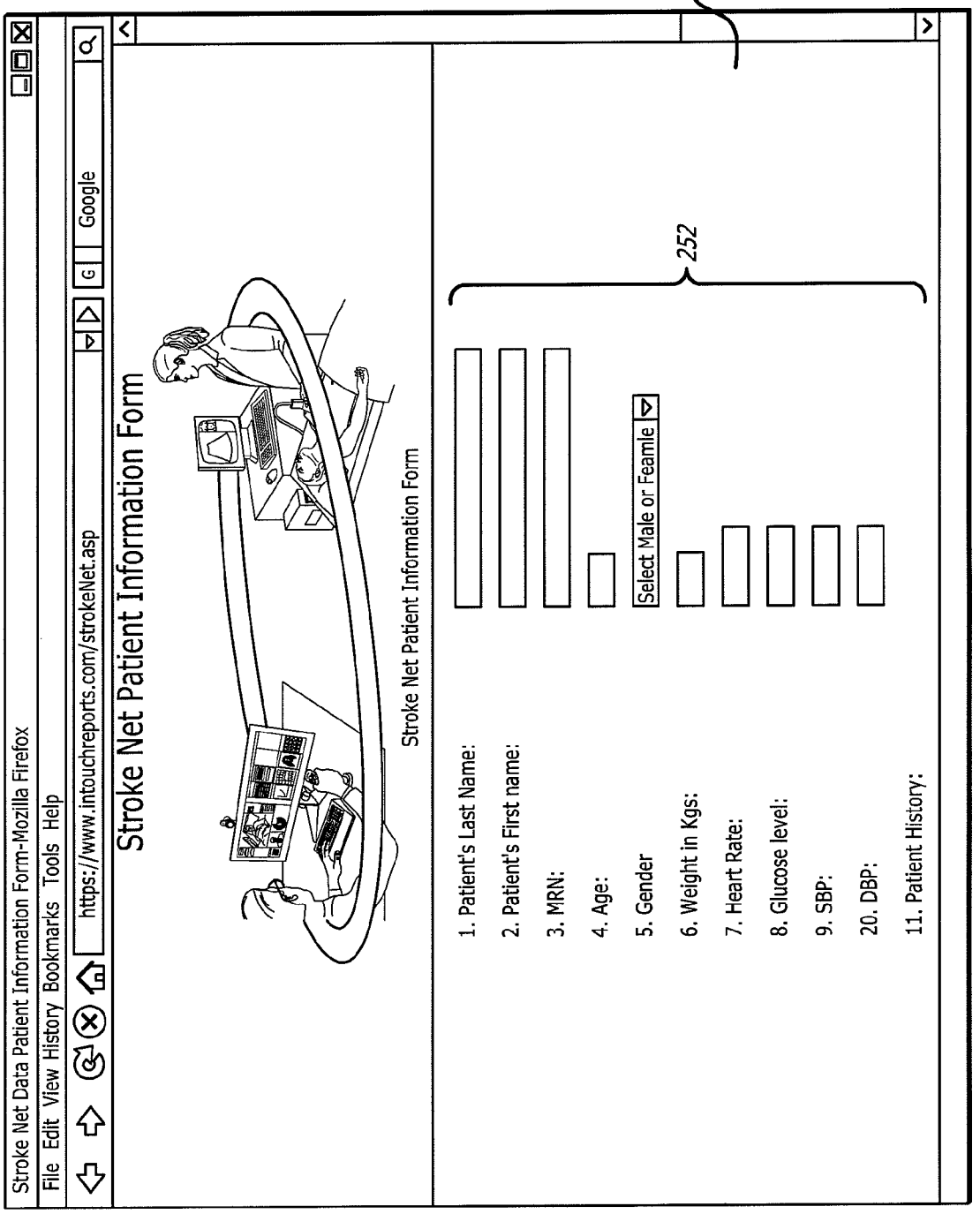

Stroke Net Data Patient Information Form-Mozilla Firefox
File Edit View History Bookmarks Tools Help
https://www.intouchreports.com/strokeNet.asp
Google
Stroke Net Patient Information Form
Stroke Net Patient Information Form
1. Patient's Last Name:
2. Patient's First name:
3. MRN:
4. Age:
5. Gender
Select Male or Feamle
6. Weight in Kgs:
7. Heart Rate:
8. Glucose level:
9. SBP:
20. DBP:
11. Patient History:
250
252

FIG. 8

FIG. 9

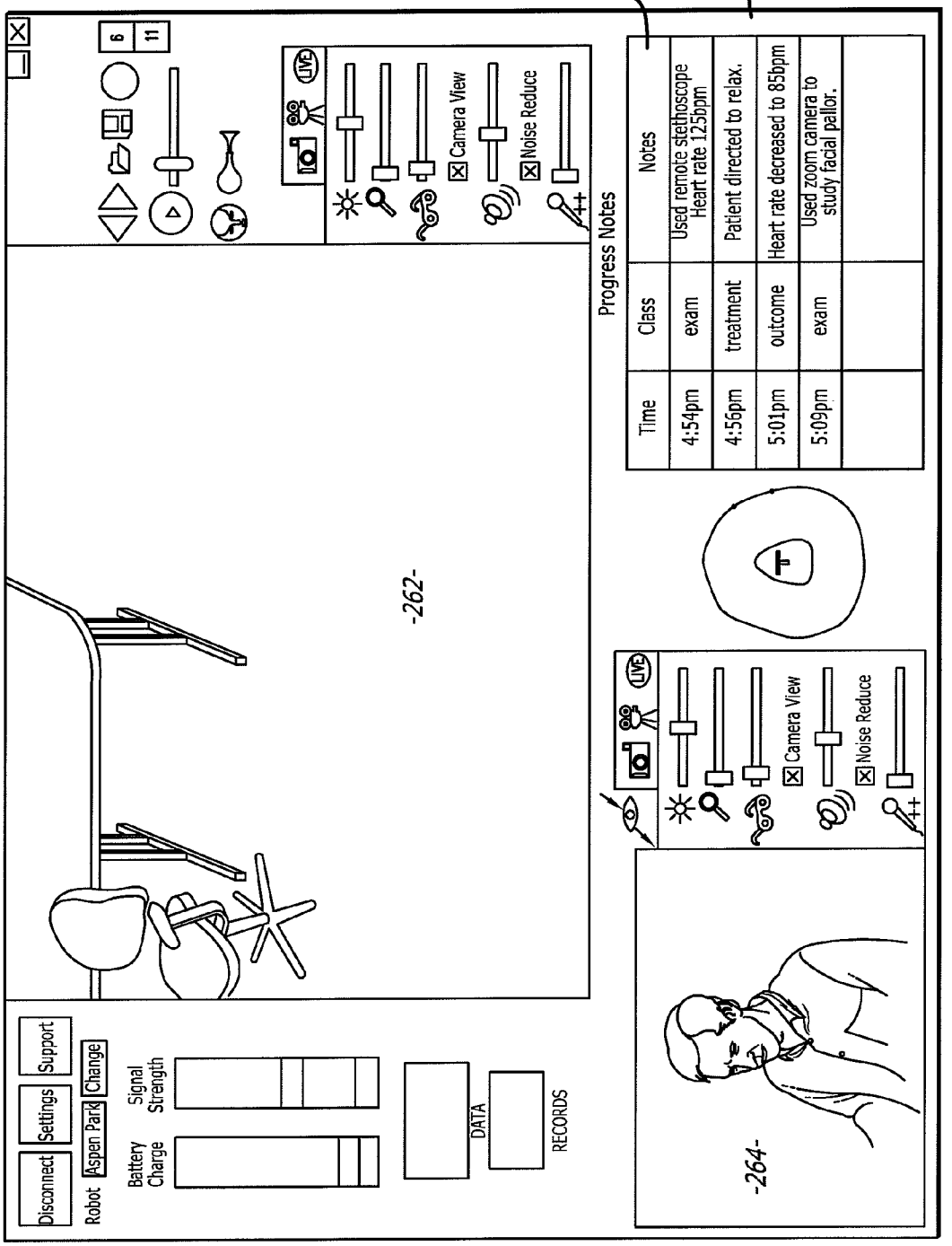

264
260
Progress Notes
Time
Class
Notes
4:54pm
exam
Used remote stethoscope Heart rate 125bpm
4:55pm
treatment
Patient directed to relax.
5:01pm
outcome
Heart rate decreased to 85bpm
5:09pm
exam
Used zoom camera to study facial pallor.
Camera View
Noise Reduce
LIVE
-262-
-264-
Disconnect
Settings
Support
Robot
Aspen Park
Change
Battery Charge
Signal Strength
DATA
RECORDS

FIG. 10

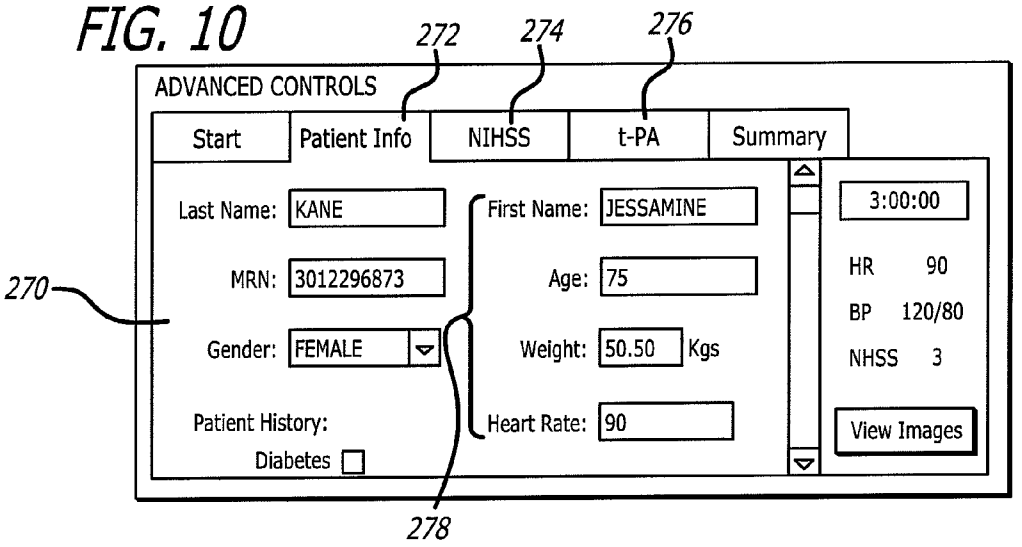


FIG. 11

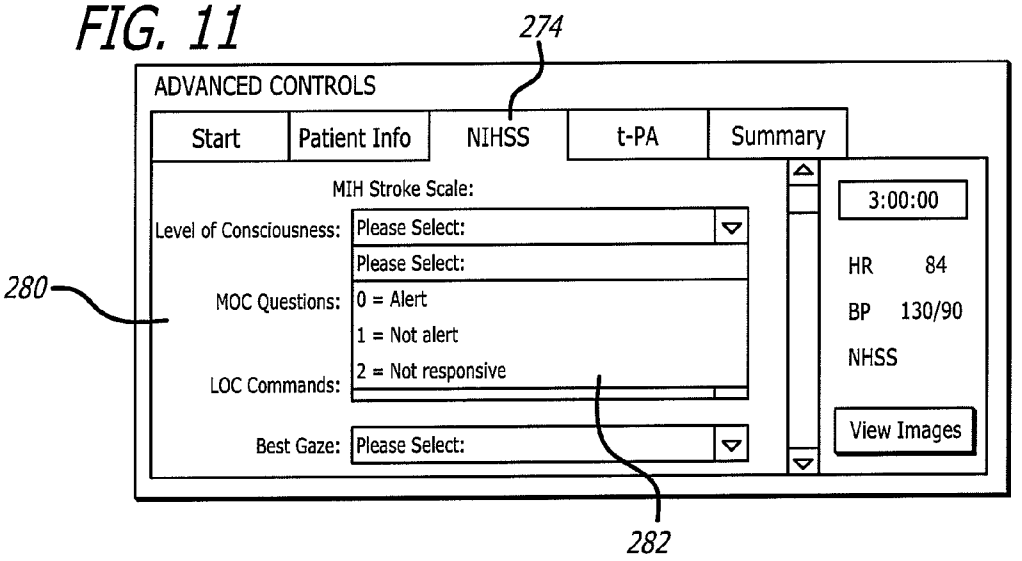
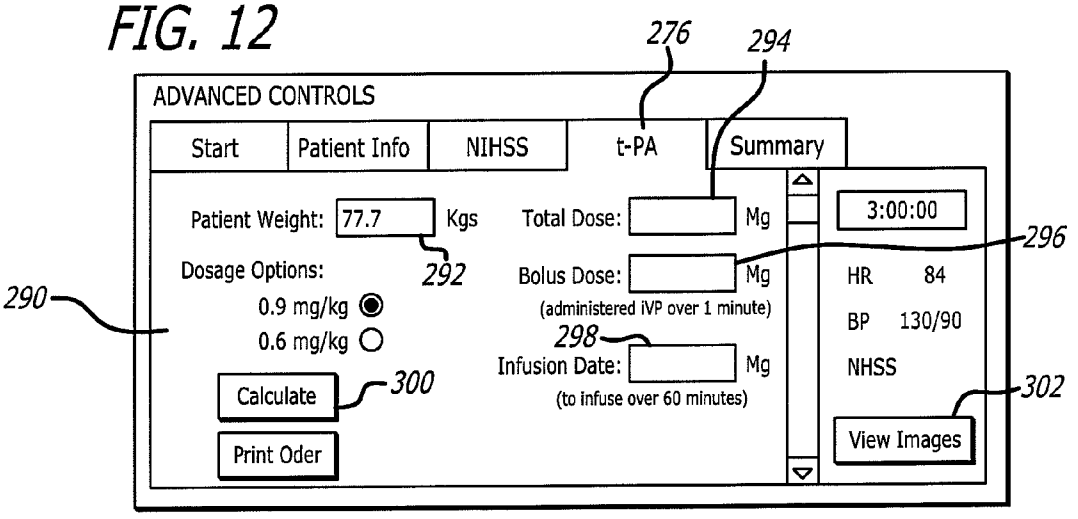


FIG. 12



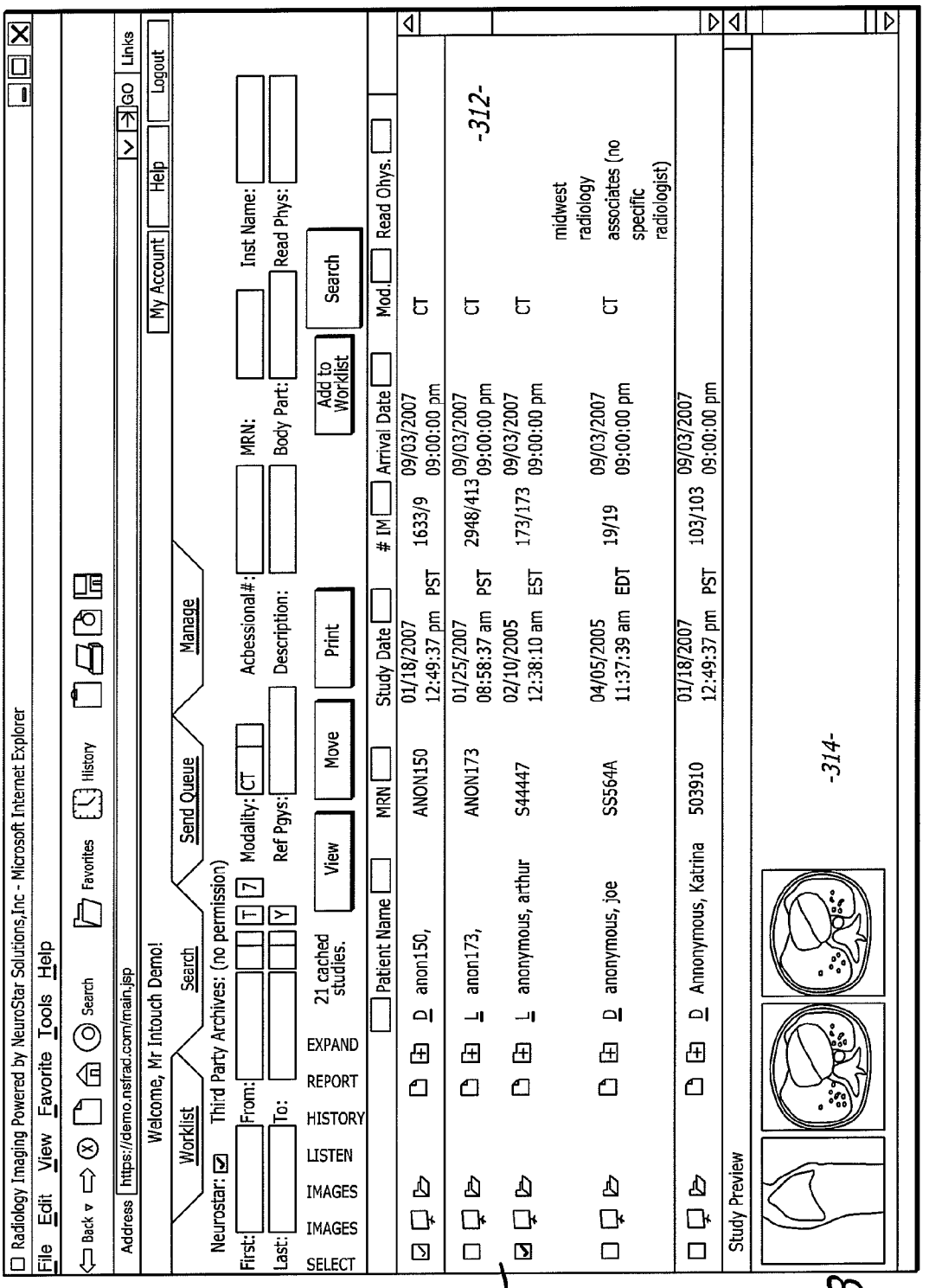

Radiology Imaging Powered by NeuroStar Solutions,Inc - Microsoft Internet Explorer
File Edit View Favorite Tools Help
Address https://demo.nstrad.com/main.jsp
Links
Welcome, Mr Intouch Demo!
My Account Help Logout
Worklist Search Send Queue Manage
Neurostar: Third Party Archives: (no permission)
First: From: Modality: CT Acbessional#: MRN: Inst Name:
Last: To: Ref Pgys: Description: Body Part: Read Phys:
21 cached studies.
View Move Print Add to Worklist Search
EXPAND
REPORT
HISTORY
LISTEN
IMAGES
IMAGES
SELECT
Patient Name MRN Study Date # IM Arrival Date Mod. Read Phys.
anon150, ANON150 01/18/2007 12:49:37 pm PST 1633/9 09/03/2007 09:00:00 pm CT
anon173, ANON173 01/25/2007 08:58:37 am PST 2948/413 09/03/2007 09:00:00 pm CT
anonymous, arthur S44447 02/10/2005 12:38:10 am EST 173/173 09/03/2007 09:00:00 pm CT
anonymous, joe SS564A 04/05/2005 11:37:39 am EDT 19/19 09/03/2007 09:00:00 pm CT midwest radiology associates (no specific radiologist)
Annonymous, Katrina 503910 01/18/2007 12:49:37 pm PST 103/103 09/03/2007 09:00:00 pm
Study Preview
-312-
-314-
310

FIG. 13

DOCUMENTATION THROUGH A REMOTE PRESENCE ROBOT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to a robotic tele-presence system.

2. Background Information

Robots have been used in a variety of applications ranging from remote control of hazardous material to assisting in the performance of surgery. For example, U.S. Pat. No. 5,762,458 issued to Wang et al. discloses a system that allows a surgeon to perform minimally invasive medical procedures through the use of robotically controlled instruments. One of the robotic arms in the Wang system moves an endoscope that has a camera. The camera allows a surgeon to view a surgical area of a patient.

There has been marketed a mobile robot introduced by InTouch-Health, Inc., the assignee of this application, under the trademark RP-7. The InTouch robot is controlled by a user at a remote station. The remote station includes personal computer with a joystick that allows the user to remotely control the movement of the robot. Both the robot and remote station have cameras, monitors, speakers and microphones to allow for two-way video/audio communication.

The InTouch RP-7 system is used by medical personnel to remotely "visit" a patient. The system is particularly useful for medical specialist. For example, medical personnel specializing in patient stroke care can remotely examine, diagnose and prescribe a patient management plan. With the proliferation of such robots it would be desirable to track and store data related to tele-presence sessions.

BRIEF SUMMARY OF THE INVENTION

A robotic system with a robot that has a camera and a remote station coupled to the robot. The remote station controls the robot in a session that results in session content data. The system further includes a storage device that stores the session content data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a robotic system;

FIG. **2** is an illustration showing a user interface;

FIG. **3** is an illustration of a user interface displaying events and associated time stamps;

FIG. **4** is an illustration of a user interface with selectable fields;

FIG. **5** is an illustration showing the display of a pull-down menu;

FIG. **6** is an illustration showing a session field displayed in response to the selection of a field;

FIG. **7** is a schematic of an electrical system of a robot;

FIG. **8** is a graphical user interface of a user interface;

FIG. **9** is a graphical user interface at a remote station;

FIG. **10** is a graphical user interface at the remote station;

FIG. **11** is a graphical user interface when a NIHSS tab is selected;

FIG. **12** is a graphical user interface displayed when a t-PA table is selected

FIG. **13** is a graphical user interface displayed when a view images button is selected.

DETAILED DESCRIPTION

Disclosed is a robotic system that is used in a tele-presence session. For example, the system can be used by medical personnel to examine, diagnose and prescribe medical treatment in the session. The system includes a robot that has a camera and is controlled by a remote station. The system further includes a storage device that stores session content data regarding the session. The data may include a video/audio taping of the session by the robot. The session content data may also include time stamps that allow a user to determine the times that events occurred during the session. The session data may be stored on a server that is accessible to multiple users. Billing information may be automatically generated using the session data.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a robotic system **10**. The robotic system **10** includes one or more robots **12**. Each robot **12** may have a base station **14**. The robot **12** is coupled to a remote control station **16**. The remote control station **16** may be coupled to the base station **14** through a network **18**. By way of example, the network **18** may be either a packet switched network such as the Internet, or a circuit switched network such has a Public Switched Telephone Network (PSTN) or other broadband system. The base station **14** may be coupled to the network **18** by a modem **20** or other broadband network interface device. By way of example, the base station **14** may be a wireless router. Alternatively, the robot **12** may have a direct connection to the network **18** through, for example, a satellite.

The remote control station **16** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **16** is typically located in a place that is remote from the robot **12**. Although only one remote control station **16** is shown, the system **10** may include a plurality of remote stations. In general any number of robots **12** may be controlled by any number of remote stations **16** or other robots **12**. For example, one remote station **16** may be coupled to a plurality of robots **12**, or one robot **12** may be coupled to a plurality of remote stations **16**, or a plurality of robots **12**.

Each robot **12** includes a movement platform **34** that is attached to a robot housing **36**. The robot **12** may also have a camera **38**, a monitor **40**, a microphone(s) **42** and a speaker(s) **44**. The microphone **42** and speaker **30** may create a stereophonic sound. The robot **12** may also have an antenna **46** that is wirelessly coupled to an antenna **48** of the base station **14**. The system **10** allows a user at the remote control station **16** to move the robot **12** through operation of the input device **32**. The robot camera **38** is coupled to the remote monitor **24** so that a user at the remote station **16** can view someone at the robot site such as a patient. Likewise, the robot monitor **40** is coupled to the remote camera **26** so that someone at the robot site can view the user. The microphones **28** and **42**, and speakers **30** and **44**, allow for audible communication between the robot site and the user of the system.

The remote station computer **22** may operate Microsoft OS software and WINDOWS XP or other operating systems such as LINUX. The remote computer **22** may also operate a video driver, a camera driver, an audio driver and a joystick driver. The video images may be transmitted and received with compression software such as MPEG CODEC.

The system **10** can be used to engage in a session that results in data. For example, the system **10** can be used by medical personnel to remotely examine, diagnose and prescribe a patient management plan for a patient **50** in a medical session. Either the patient, or a bed supporting the patient, may have a radio frequency information device ("RFID") **52**. The RFID **52** may wirelessly transmit information that is received by the robot **12** through antennae **46**. The RFID

information can be used to correlate a particular session with a specific patient. The receipt of RFID information may initiate the storage of session data. Although a medical session is described, it is to be understood that other types of sessions may be conducted with the system **10**. For example, the system **10** may be used to move the robot(s) about a factory floor wherein the user provides remote consultation. Consultation session data may be stored by the system **10**.

The system can store and display session content data. Session content data is information regarding the substance of a session. For example, in a medical application, session content data would include physician notes, diagnosis and prescription information. In a factory-equipment repair application, session content data would include repair methodology and replaced parts. Session content data would not be mere time entries associated with the logging on and termination of a robot session.

The system **10** may include a records server **54** and/or a billing server **56** that can be accessed through the network **18**. The servers **54** and **56** may include memory, processors, I/O interfaces and storage devices such as hard disk drives, as is known in the art. Records server **54** may have a storage device(s) **57** that stores session data. The server **54** may receive and store session data during a session. For example, the server **54** may receive and store video and audio captured by the robot camera **38** and microphone **42**, respectively. To reduce bandwidth requirements during a session the session data, such as video/audio segments, can be transmitted from the robot **12** to the server **54** after the session has terminated. For example, when the user logs off the system. Timestamped progress notes are also simultaneously uploaded. The server **54** may contain other medical records of a patient such as written records of treatment, patient history, medication information, laboratory results, physician notes, etc. Video/audio segments can be timestamped and associated with the identification of the control station and the robot, and a unique identifier which can be cross-referenced with progress notes and other session data. These video/audio segments can then later be used to substantiate and reference the various progress notes and other events in a visual fashion. The system can track all head and base movements made during the course of the associated portion of the session, to allow correlation of those movements with the actions taken.

The system **10** may include a user interface **58** that allows a user at the remote location to enter data into the system. For example, the interface **58** may be a computer or a computer terminal that allows a user to enter information about the patient. The robot **12** can be moved into view of the patient through the remote station **16** so that patient information can be entered into the system while a physician is viewing the patient through the robot camera. The physician can remotely move the robot **12** to obtain different viewing angles of the patient. The user interface **58** may be a separate computer and/or be integral with the robot **12**. The billing server **56** may automatically generate a bill from the information provided by the session data on a periodic basis. The billed elements may be based on either actions performed or outcomes achieved, or both. Alternatively, a user can manually generate bills through a user interface to the billing server.

The billing server **56** may receive session data during a session or upon termination of a session. Additionally, the billing server may poll a robot to retrieve data from its hard drive. The session data may be organized so as to automatically populate certain fields of a billing statement or report. The billing information can be automatically sent to an insurance carrier.

The server **54** can be accessible through a web page or other means for accessing information through a network **18**. FIG. **2** shows a user interface **62** displayed at a remote station **16**, or any other terminal that can access the server **54**. The interface **62** can for example, provide a date and time that various physicians had sessions with different patients. FIG. **3** shows another user interface **64** that displays time stamps **66** that are associated with certain events **68**. Records can be retrieved by various filters including physician name, patient name, time of session and services performed during the session. The event data can be initially stored in either the robot **12** or the remote station **16** and then loaded into the server **54**, either during or after a session. Alternatively, event data can be directly loaded into the server without storing it locally on the robot or remote station.

The session data can be organized into a plurality of data types. FIG. **4** shows a plurality of different data types. For example, the session data can be organized into ENCOUNTER PROFILE data **70**, PATIENT PROFILE data **72** and CLINICAL MANAGEMENT PROFILE data **74**, with each having subfields such as EVENT and HISTORY. FIG. **5** shows a pull-down screen **78** that is displayed when a DEMOGRAPHICS field **76** is selected. FIG. **6** shows a field **80** that displays a number of sessions that match a selected HISPANIC field **82**. The session data can be searched with Boolean operators such as AND and OR to search for multiple terms, data types, etc. The user can display all hits for the search, or have a statistical analysis performed based on the matching sessions.

In a factory equipment-repair application, the equipment being repaired during the session would replace the patient name in FIG. **2**; and steps for repair would replace the event list in FIG. **3**. Repair methodologies and affected part numbers would replace the search criteria in FIGS. **4**, **5** and **6**. Captured video and audio would show the steps in the repair process, and would be timestamped and cross-referenced to the data in FIG. **3**.

Referring to FIG. **1**, the system **10** may also include an image server **84** and a registry server **86**. The image server **84** may include medical images. For example, the medical images may include CT scans of a patient's brain. The images can be downloaded to one of the remote stations **16** through the network **18**. The registry server **86** may store historical data on patients. The historical data can be downloaded to a remote computer **16** through the network **18**.

FIG. **7** shows an embodiment of a robot **12**. Each robot **12** may include a high level control system **160** and a low level control system **162**. The high level control system **160** may include a processor **164** that is connected to a bus **166**. The bus is coupled to the camera **38** by an input/output (I/O) port **168**, and to the monitor **40** by a serial output port **170** and a VGA driver **172**. The monitor **40** may include a touchscreen function that allows a user to enter input by touching the monitor screen.

The speaker **44** is coupled to the bus **166** by a digital to analog converter **174**. The microphone **42** is coupled to the bus **166** by an analog to digital converter **176**. The high level controller **160** may also contain random access memory (RAM) device **178**, a non-volatile RAM device **180** and a mass storage device **182** that are all coupled to the bus **172**. The RAM **178**, NVRAM **180** and/or mass storage device **182** may contain session data that is transmitted to the remote station and/or server. The robot antennae **46** may be coupled to a wireless transceiver **184**. By way of example, the transceiver **184** may transmit and receive information in accordance with IEEE 802.11b.

The controller **164** may operate with a LINUX OS operating system. The controller **164** may also operate MS WINDOWS along with video, camera and audio drivers for communication with the remote control station **16**. Video information may be transceived using MPEG CODEC compression techniques. The software may allow the user to send e-mail to the patient and vice versa, or allow the patient to access the Internet. In general the high level controller **160** operates to control communication between the robot **12** and the remote control station **16**.

The high level controller **160** may be linked to the low level control system **162** by a serial port **186**. The low level control system **162** may include components and software that mechanically actuate the robot **12**. For example, the low level control system **162** provides instructions to actuate the movement platform to move the robot **12**. The low level control system **162** may receive movement instructions from the high level controller **160**. The movement instructions may be received as movement commands from the remote control station or another robot. Although two controllers are shown, it is to be understood that each robot **12** may have one controller, or more than two controllers, controlling the high and low level functions.

The system may be the same or similar to a robotic system provided by the assignee InTouch Technology, Inc. of Santa Barbara, Calif. under the name RP-7, which is hereby incorporated by reference. The system may also be the same or similar to the system disclosed in U.S. Pat. No. 7,292,912, which is hereby incorporated by reference.

FIG. **8** shows a graphical user interface **250** can be provided at the user interface **58**. The graphical user interface **250** includes a plurality of data fields **252** that can be filled by the user. The data fields **252** can request patient information such as name, age, etc. The data fields may also include request for medical data such as heart rate, glucose level and blood pressure ("SBP" and "DBP"). The data entered into the fields **252** can be included in the session data that is transmitted and stored by the system **10**. Filling the data fields may be designated an "event" that is given as associated time stamp and displayed by a user interface.

FIG. **9** shows a display user interface ("DUI") **260** that can be displayed at the remote station **16**. The DUI **260** may include a robot view field **262** that displays a video image captured by the camera of the robot. The DUI **260** may also include a station view field **264** that displays a video image provided by the camera of the remote station **16**. The DUI **260** may be part of an application program stored and operated by the computer **22** of the remote station **16**. The video and any accompanying audio displayed by the robot and station view fields may be transmitted and stored by the system **10** as session data.

The DUI **260** may contain a "progress notes" text editing field, which enables a "document as you treat" methodology. As the physician conducts treatment, he can document both the treatment steps and outcomes in the progress notes field. Each note may be manually timestamped by the physician, or automatically timestamped by the software based on when the physician began typing each note. In the application of factory floor equipment repair, the progress notes would detail the various examinations and repair steps taken.

FIG. **10** shows a graphical user interface **270** that can be displayed by the monitor of the remote station **16**. The interface **270** includes a "PATIENT INFO" tab **272**, a "NIHSS" tab **274** and a "t-PA" tab **276**. Selection of the PATIENT INFO tab **272** displays various data fields **278** including patient name, age, weight, heart rate, etc. This may be the same information entered through the user interface **250**. This information may be included in the session data that is transmitted and stored by the system **10**. The usage of this interface may be tagged as an event with an associated time stamp.

FIG. **11** shows an interface **280** when the "NIHSS" tab **274** is selected. The interface **280** has a data field **282** that provides a questionnaire to rate the severity of a stroke victim using the NIHSS stroke scale. This provides a readily available medical tool for the physician. The results of the questionnaire can be included in the session data and be tagged as an event that has an associated time stamp.

FIG. **12** shows an interface **290** when the "t-PA" tab **276** is selected. The interface **290** may include a data field **292** that provides the patient's weight, a "TOTAL DOSE" data field **294**, a "BOLUS DOSE" data field **296** and an "INFUSION DOSE" data field **298**. The interface **290** may also include a "CALCULATE" button **300**. When the CALCULATE button **300** is selected the data fields **294**, **296** and **298** are automatically populated with a calculated dosage. This provides a patient management plan for the physician to review. The interfaces **270**, **280** and **290** also have a "VIEW IMAGES" button **302** that when selected displays an interface **310** shown in FIG. **13**. The interface **310** includes a data field **312** and an image field **314**. The image field **314** can provide a plurality of medical images such as a CT scan of the patient's head.

The calculated dosage and images can be included in the session data that is transmitted and stored by the system. The automatic population of the data fields may be tagged as an event with an associated time stamp. Likewise, the selection of the data and/or image fields may be tagged as events with time stamps.

The system is useful for allowing a physician to remotely view and treat a stroke patient. The system provides patient information, NIHSS stroke severity assessment, calculated t-PA dosage and CT head images that allow the physician to provide real time remote patient treatment. The system also allows such sessions to be audited so that medical personnel, healthcare institutions, insurance carriers, etc. can audit sessions. Such audits may include viewing video/audio captured by the robot during a session.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A robotic system, comprising:

a robot that has a robot camera, a robot monitor, a robot microphone, and a robot speaker;

a remote station that has a station camera, a station monitor, a station microphone, and a station speaker, said remote station and said robot are capable of establishing a telepresence session during which said station monitor is coupled to said robot camera and displays a robot image captured by said robot camera, said robot monitor is coupled to said station camera and displays a station image captured by said station camera, said station speaker is coupled to said robot microphone, and said robot speaker is coupled to said station microphone to enable two-way audio communication between said robot and said remote station, said remote station controls said robot during said telepresence session and said telepresence session results in session content data that is non-image and non-audio data; and,

a storage device that stores said session content data during said telepresence session.

2. The system of claim **1**, wherein said storage device includes a server.

3. The system of claim **1**, wherein said session content data is correlated with a movement of said robot.

4. The system of claim **1**, wherein said session content data is searchable.

5. The system of claim **1**, wherein said session content data includes at least one time stamp.

6. The system of claim **5**, wherein said remote station provides a graphical user interface that displays said time stamp and said session content data.

7. The system of claim **6**, wherein said session content data is entered by an operator at said remote station.

8. The system of claim **7**, wherein said time stamp is automatically generated when said session content data is entered by the operator.

9. The system of claim **1**, further comprising a billing server that generates a bill with said session content data.

10. The system of claim **1**, further comprising a bill that is based on an action of said session content data.

11. The system of claim **1**, wherein said session content data is structured into a plurality of data types and is searchable across said data types.

12. A robotic system, comprising:

a robot that has a camera that captures an image;

a remote station that has a station camera, a station monitor, a station microphone, and a station speaker, said remote station and said robot are capable of establishing a telepresence session during which said station monitor is coupled to said robot camera and displays a robot image captured by said robot camera, said robot monitor is coupled to said station camera and displays a station image captured by said station camera, said station speaker is coupled to said robot microphone, and said robot speaker is coupled to said station microphone to enable two-way audio communication between said robot and said remote station, said remote station controls said robot in a session that results in session content data that is non-image and non-audio data; and,

means for storing said session content data.

13. The system of claim **12**, wherein said session content data is searchable.

14. The system of claim **12**, wherein said session content data includes at least one time stamp.

15. The system of claim **14**, wherein said remote station provides a graphical user interface that displays said time stamp and said session content data.

16. The system of claim **15**, wherein said session content data is entered by an operator at said remote station.

17. The system of claim **16**, wherein said time stamp is automatically generated when said session content data is entered by the operator.

18. The system of claim **12**, further comprising a billing server that generates a bill with said session content data.

19. The system of claim **12**, further comprising a bill that is based on an action of said session content data.

20. The system of claim **12**, wherein said session content data is structured into a plurality of data types and is searchable across said data types.

21. A method for conducting a tele-presence session, comprising:

moving a robot through control of a remote station, the robot has a robot camera, a robot monitor, a robot microphone and a robot speaker, the remote station includes a station camera, a station monitor, a station microphone and a station speaker;

establishing a telepresence session during which the station monitor is coupled to the robot camera and display a robot image captured by the robot camera, said robot monitor is coupled to the station camera and displays a station image captured by the station camera, the station speaker is coupled to the robot microphone, and the robot speaker is coupled to the station microphone to enable two-way audio communication between said robot and the remote station;

engaging in a session that results in session content data that is non-image and non-audio data; and,

storing the session content data during the telepresence session.

22. The method of claim **21**, wherein the session content data is searchable.

23. The method of claim **21**, further comprising generating at least one time stamp for the session content data.

24. The method of claim **23**, further comprising displaying the time stamp and the session content data.

25. The method of claim **24**, wherein the session content data is entered by an operator at the remote station.

26. The method of claim **25**, wherein the time stamp is automatically generated when the session content data is entered by the operator.

27. The method of claim **21**, further comprising transmitting a video image of a user at the control station to a monitor of the robot.

28. The method of claim **21**, further comprising automatically generating a bill with the session content data.

29. The method of claim **21**, further comprising structuring the session content data into a plurality of data types and searching the session content data across the data types.

* * * * *

Exhibit E

US008780165B2

(12) **United States Patent**
Wang et al.

(10) **Patent No.: US 8,780,165 B2**
(45) **Date of Patent: *Jul. 15, 2014**

(54) **PORTABLE REMOTE PRESENCE ROBOT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 12/548,122, filed on Aug. 26, 2009, now Pat. No. 8,384,755.

(51) **Int. Cl.**
H04N 7/14 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 7/14*** (2013.01)
USPC **348/14.05**; 348/14.07

(58) **Field of Classification Search**
USPC 348/14.01–14.09, 14.1, 14.11, 14.12; 709/203, 204; 700/13, 90, 245; 901/14, 901/19, 46
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0082642 A1 * 4/2006 Wang et al. 348/14.05
2007/0064092 A1 * 3/2007 Sandbeg et al. 348/14.02

* cited by examiner

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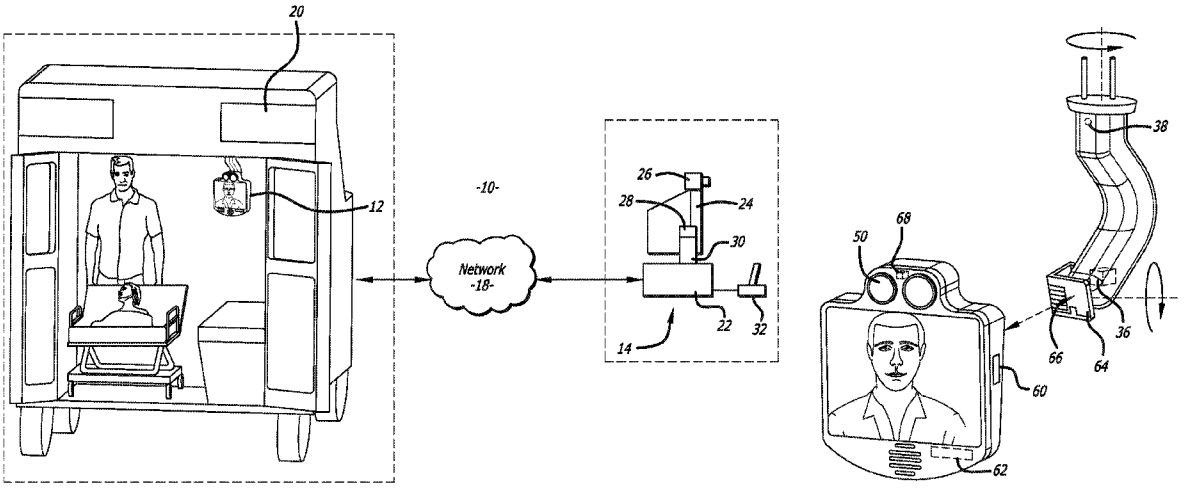
(74) *Attorney, Agent, or Firm* — Chris Lambrecht

(57) **ABSTRACT**

A tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The portable robot face can be attached to a platform mounted to the ceiling of an ambulance. The portable robot face can be used by a physician at the remote station to provide remote medical consultation. When the patient is moved from the ambulance the portable robot face can be detached from the platform and moved with the patient.

5 Claims, 5 Drawing Sheets



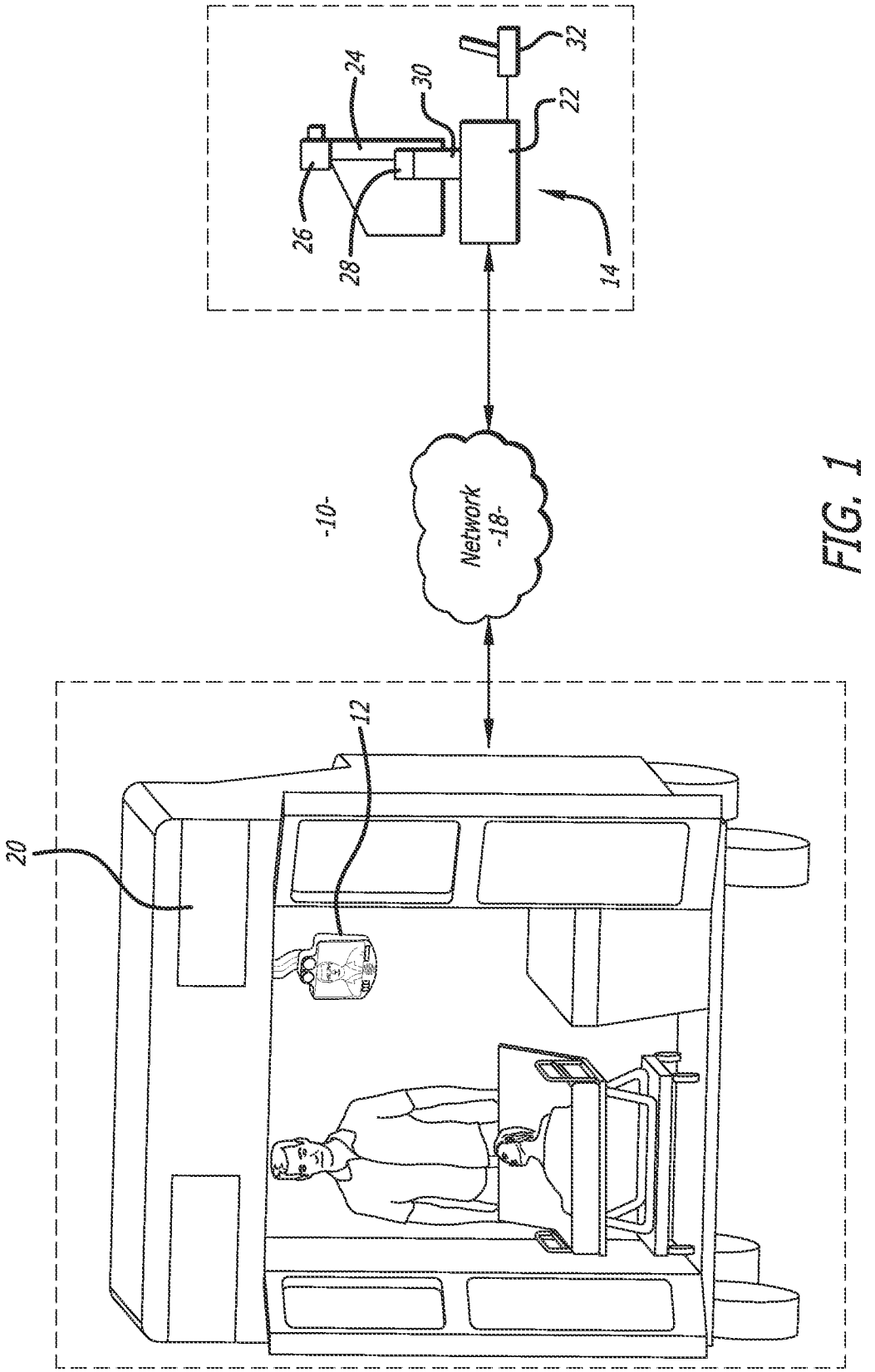


FIG. 1

FIG. 2

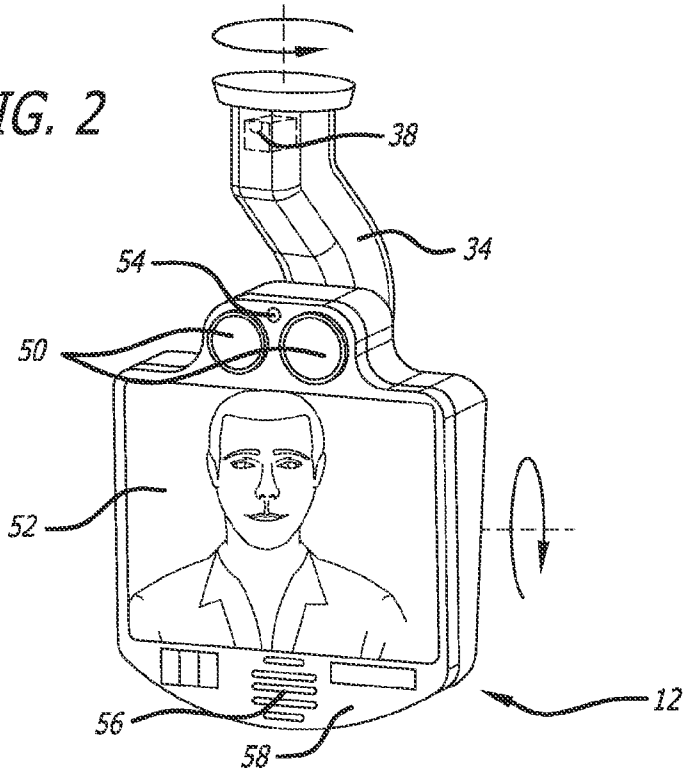
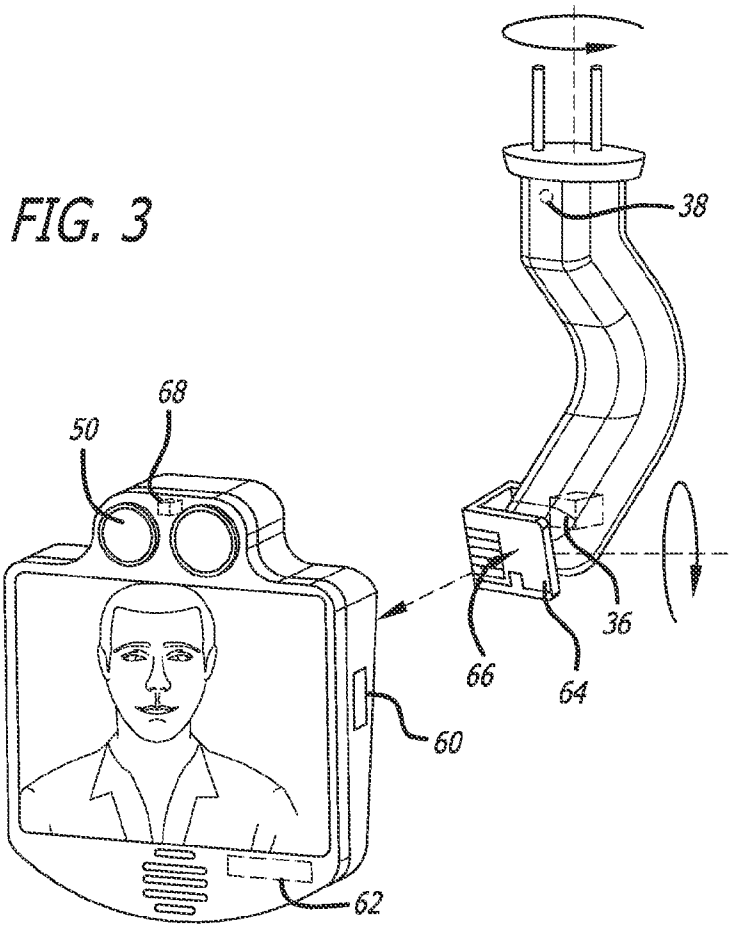


FIG. 3



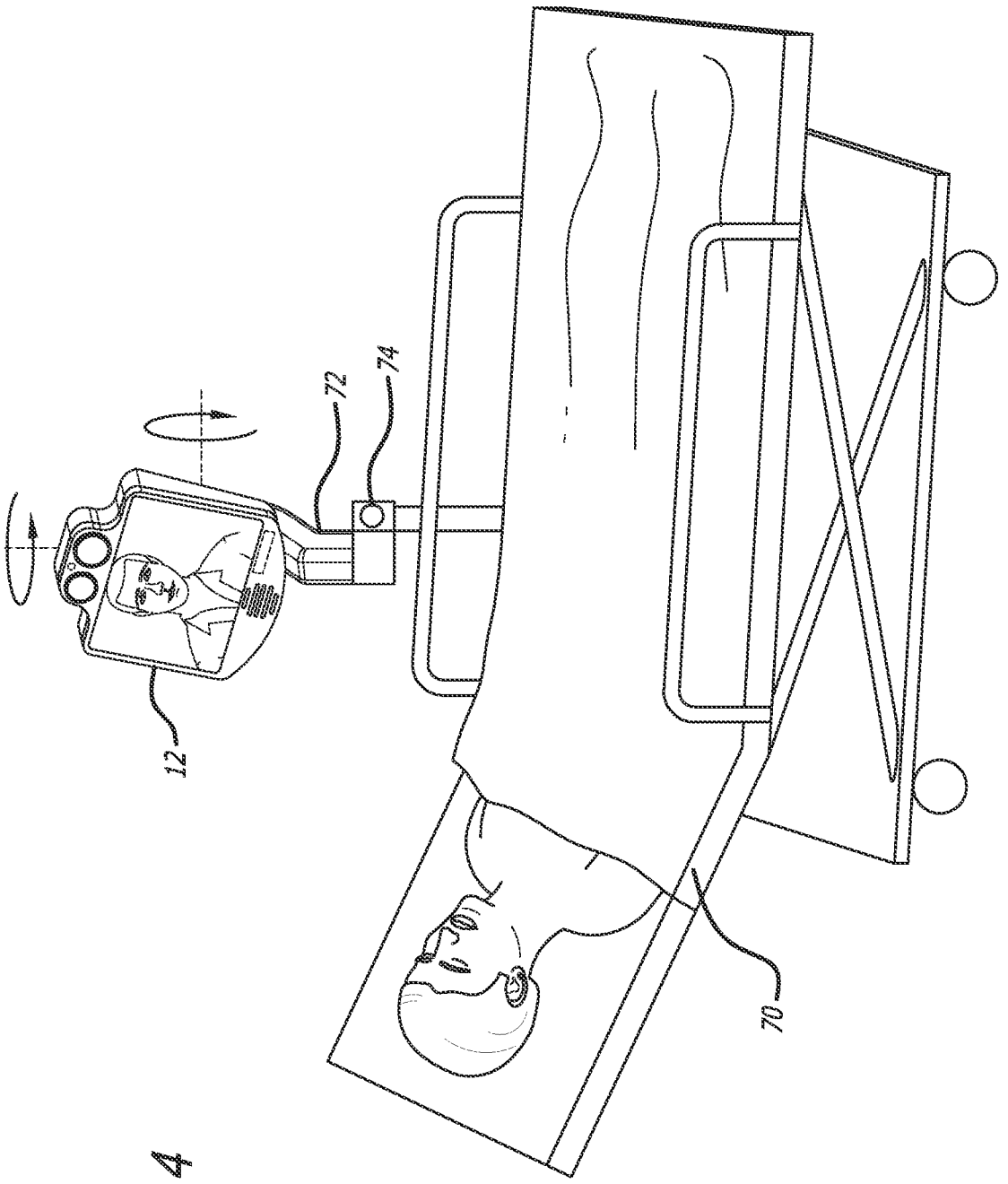


FIG. 4

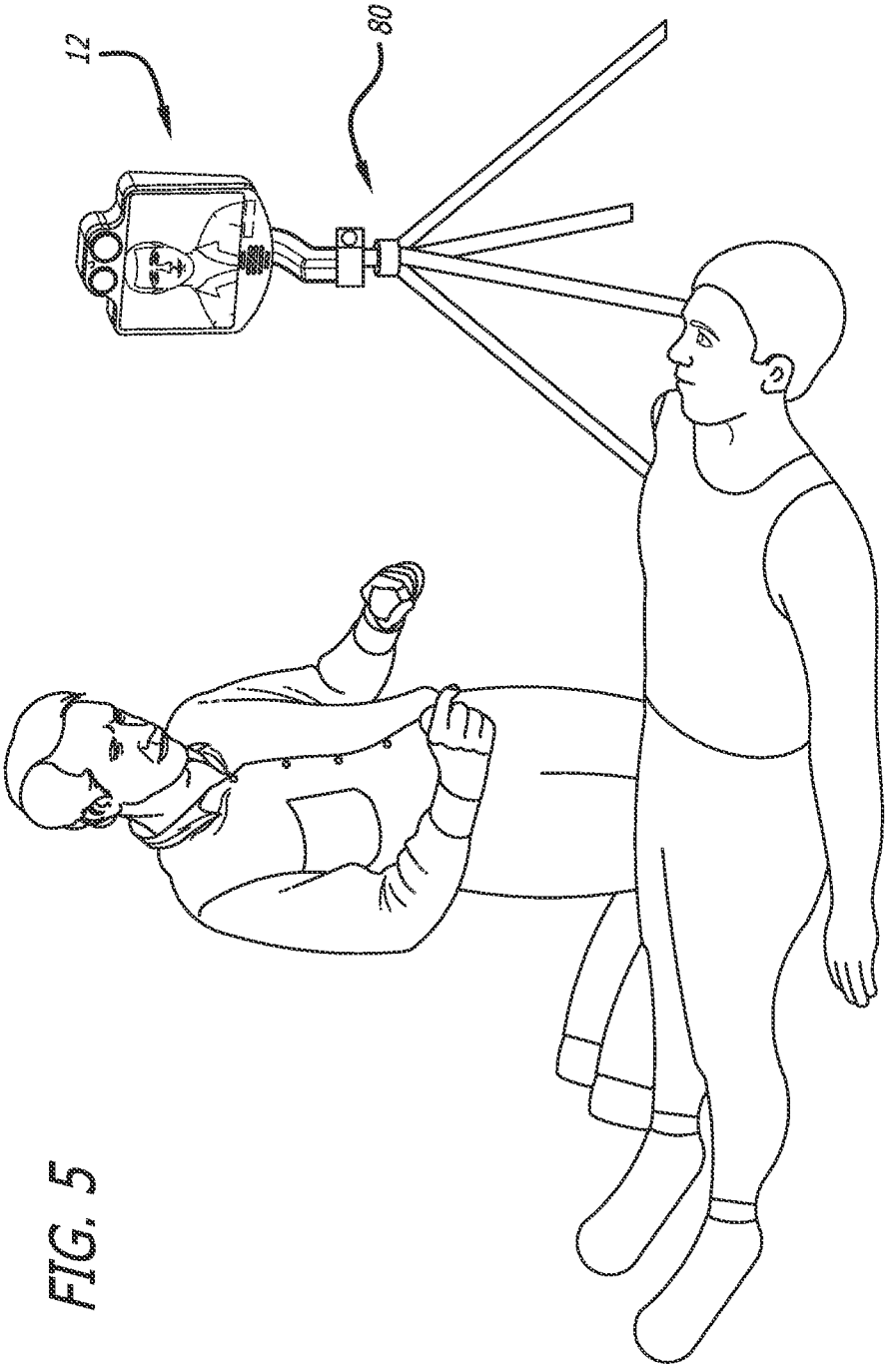
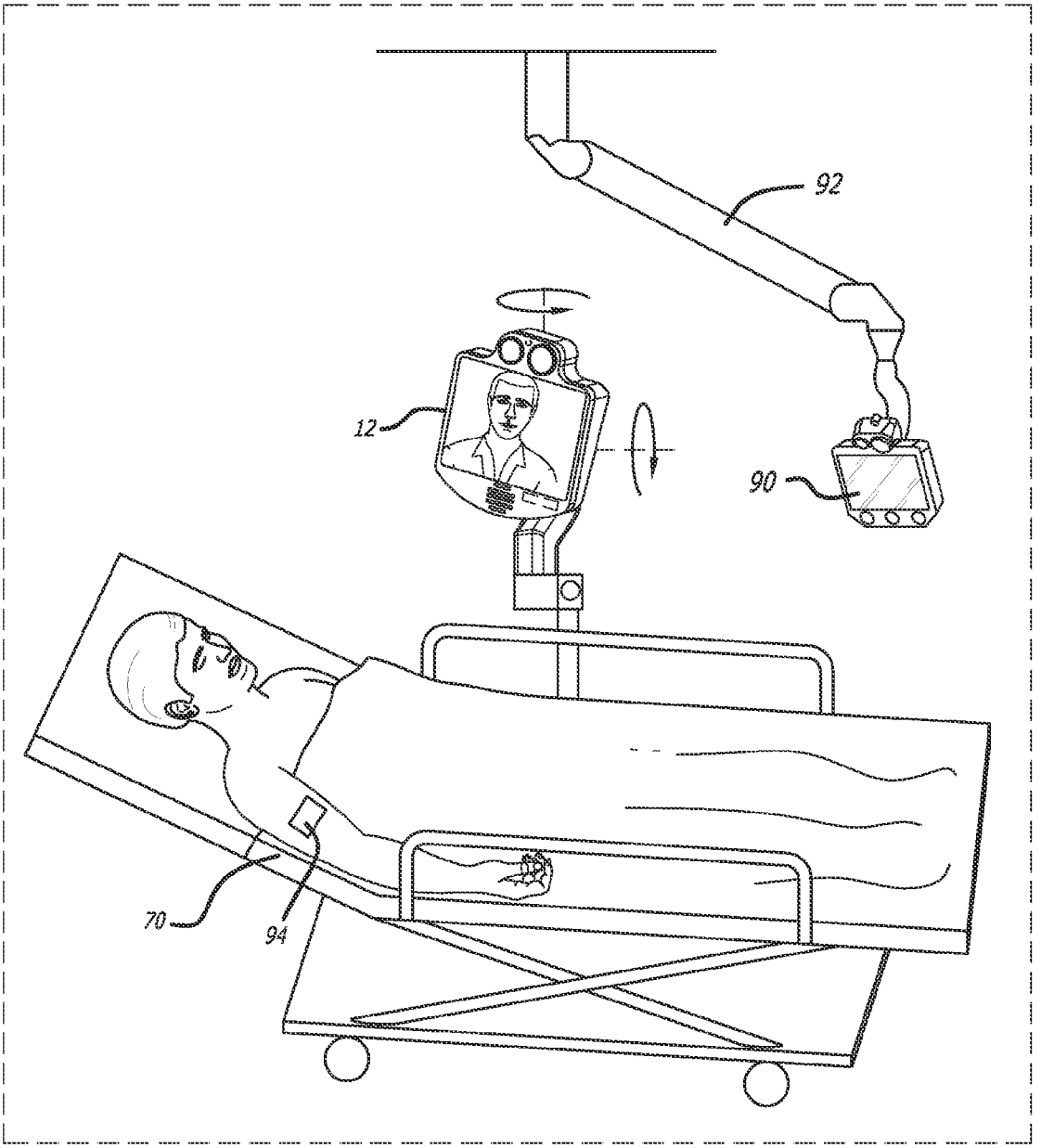


FIG. 5

FIG. 6



PORTABLE REMOTE PRESENCE ROBOT

CROSS-REFERENCE TO RELATED APPLICATION

This is a continuation of U.S. application Ser. No. 12/548,122 filed Aug. 26, 2009.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the field of robotic tele-presence systems.

2. Background Information

Robots have been used in a variety of applications. For example, robots have been used in manufacturing facilities, bomb detection/detonation, medical facilities, etc. The assignee of the present application has developed a tele-presence robot that includes a robot that is remotely controlled through a remote control station. The system is marketed under the product name RP-7. Both the robot and the remote station include cameras, monitors, microphones and speakers to allow for two audio-visual communication. The remote station also includes a joystick that can be operated by the user to move the robot and a robot head.

BRIEF SUMMARY OF THE INVENTION

A tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a tele-presence system that includes a remote station coupled to a portable robot face located within an ambulance;

FIG. **2** is an illustration showing the portable robot face within the ambulance;

FIG. **3** is an illustration showing the portable robot face detached from a platform mounted to the ambulance ceiling;

FIG. **4** is an illustration showing the portable robot face attached to a patient gurney;

FIG. **5** is an illustration showing the portable robot face attached to a stand;

FIG. **6** is an illustration showing a patient within a healthcare facility that has a robot face attached to a boom.

DETAILED DESCRIPTION

Disclosed is a tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The portable robot face can be attached to a platform mounted to the ceiling of an ambulance. The portable robot face can be used by a physician at the remote station to provide remote medical consultation. When the patient is moved from the ambulance the portable robot face can be detached from the platform and moved with the patient.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a tele-presence system **10**. The system **10** includes a portable robot face **12** that is coupled to a remote control station **14** through a wireless network **18**. The wireless network may be a cellular broadband network and/or a WiFi network. The portable robot face **12** is located within an ambulance **20**.

The remote control station **14** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **14** is typically located in a place that is remote from the robot face **12**. Although only one remote control station **14** is shown, the system **10** may include a plurality of remote stations **14**. In general any number of robot faces **12** may be coupled to any number of remote stations **14** or other robot faces **12**. For example, one remote station **14** may be coupled to a plurality of robot faces **12**, or one robot face **12** may be coupled to a plurality of remote stations **14**, or a plurality of robot faces **12**. The system may include an arbitrator (not shown) that controls access between the robot face(s) **12** and the remote stations **14**.

As shown in FIGS. **2** and **3**, the portable robot face **12** may be attached to a platform **34**. The platform **34** may extend from the ceiling (not shown) of the ambulance **20**. The platform **34** may include articulate joints **36** and **38** that provide at least two degrees of freedom and allow a user to move the robot face **12** to different positions to view a patient and an EMT within the ambulance.

Each robot face **12** includes a camera(s) **50**, a monitor **52**, a microphone(s) **54** and a speaker(s) **56** that are all attached to a housing **58**. The robot camera **50** is coupled to the remote monitor **24** so that a user at the remote station **14** can view the patient and/or EMT. Likewise, the robot monitor **52** is coupled to the remote camera **26** so the patient and EMT may view the user of the remote station **14**. The microphones **28** and **54**, and speakers **30** and **56**, allow for audible communication between the system operator and the patient and/or EMT.

The system **10** allows a system user such as a physician to view a patient in the ambulance and provide remote medical consultation through the remote station **14** and the robot face **12**. Personnel such as the EMT can transmit questions and responses through the system back to the physician. The robot camera **50** allows the physician to view the patient and enhance the medical consultation. The robot monitor **52** can display the physician to provide a feeling of presence in the ambulance. The platform **34** allows the physician to pan and tilt the robot face **12**.

The robot face **12** may include a wireless transceiver **60** that is coupled to the wireless network. The portable face **12** also includes a battery **62**.

The system **10** may have certain components and software that are the same or similar to a robotic system provided by the assignee InTouch-Health, Inc. of Santa Barbara, Calif. under the name RP-7 and embodies a system described in U.S. Pat. No. 6,925,357, which is hereby incorporated by reference.

As shown in FIG. **3**, the portable robot face **12** can be detached from the platform **34**. The robot face **12** and platform **34** may have mechanical connectors **64** that allow the face **12** to be readily attached and detached from the platform **34**. Likewise, the robot face **12** and platform **34** may include electrical connectors **66**. The ambulance may include a wireless transceiver (not shown) that can provide wireless communication to the remote station. The electrical connectors **66** provide an electrical connection between the robot face **12** and the ambulance wireless transceiver. The connectors **66** may also provide power to the robot face **12**. Alternatively, the wireless transceiver **60** of the robot face **12** may be coupled to the remote station through the ambulance wireless transceiver. The robot face may include an actuator system **68** that

can move the camera **50** in two degrees of freedom. This allows the operator to move the camera field of view even when the face **12** is detached from the platform **34**.

As shown in FIG. **4** the portable robot face **12** can be detached from the platform (not shown) and attached to the patient gurney **70**. The robot face **12** may be attached to a platform **72** with two degrees of freedom that allow the remote station user to move the robot face **12**. The platform **72** may include a clamp **74** that allows for attachment to the gurney **70**. The robot face **12** and patient can be moved out of the ambulance on the gurney **70**. The portable aspect of the robot face **12** allows the face to be moved with the patient. The robot face **12** should be of a size and weight so that an individual can lift the face **12**.

As shown in FIG. **5** the portable robot face **12** can be detached from the ambulance platform (not shown) and attached to a stand **80** at a remote location. The portable nature of the robot face **12** allows the face **12** to be taken to any location to allow for remote tele-presence of the operator of the remote station. If the operator is a physician the portable robot face **12** allows for remote medical consultation at any site.

FIG. **6** shows the patient and gurney moved into a healthcare facility with a robot face **90** attached to a boom **92**. When the gurney **70** is moved into close proximity with the healthcare facility the robot face wireless transceiver may be coupled to the remote station thru the healthcare facility local wireless network such as a WiFi network. Once inside the facility the portable robot face can be connected to an electrical power outlet and a network for Ethernet connection. An electronic ID device **94** may be attached to the patient. The ID device **94** may transmit a wireless signal to the robot face **90** attached to the boom **92**. Receipt of the signal by the face **90** may cause the remote station to be coupled to the robot face **90** attached to the boom **92** instead of the portable robot face **12**. The robot face **90** may be coupled to the remote station by other means. For example, a nurse may type in information into the healthcare facility network system that identifies the new location of the patient. Such an entry may cause the system to switch the remote control station to the robot face **90**. Additionally, there may be other methodologies for inducing the system to automatically transfer the remote station from one robot to another robot.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A method for providing a remote medical consultation, comprising:

capturing an image of a physician with a station camera of a remote station, the remote station includes a station monitor, a station speaker and a station microphone;

transmitting the physician image to a portable robot face mounted to a platform, the robot face including a robot monitor, a robot camera, a robot speaker and a robot microphone;

capturing an image of a patient with the robot camera;

transmitting the patient image to the remote station;

displaying the patient image on the station monitor of the remote station;

transmitting an audio command from the station microphone to the robot speaker;

detaching the portable robot face from the platform;

moving the patient and the portable robot to a new location; and

displaying the physician image on the robot monitor while said portable robot face is detached from the platform.

2. The method of claim **1**, wherein the platform is attached to an ambulance.

3. The method of claim **1**, further comprising attaching the portable robot face to a patient gurney.

4. The method of claim **1**, further comprising coupling the portable robot face to a healthcare facility network through a wireless transceiver of the portable robot face.

5. The method of claim **1**, further comprising attaching a wireless identification device to the patient and moving the patient into a healthcare facility that includes a robot face attached to a boom, the robot face receives a wireless signal from the wireless identification device and the remote station becomes coupled to the robot face attached to the boom.

* * * * *

Exhibit F

US009602765B2

(12) **United States Patent**
Wang et al.

(10) **Patent No.: US 9,602,765 B2**
(45) **Date of Patent: *Mar. 21, 2017**

(54) **PORTABLE REMOTE PRESENCE ROBOT**

(71) Applicant: **InTouch Technologies, Inc.**, Goleta, CA (US)

(72) Inventors: **Yulun Wang**, Goleta, CA (US); **Charles S. Jordan**, Santa Barbara, CA (US); **Marco Pinter**, Isla Vista, CA (US); **Daniel Steven Sanchez**, Summerland, CA (US); **Kevin Hanrahan**, Santa Barbara, CA (US)

(73) Assignee: **INTOUCH TECHNOLOGIES, INC.**, Goleta, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **14/289,514**

(22) Filed: **May 28, 2014**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 13/549,971, filed on Jul. 16, 2012, now Pat. No. 8,780,165, which is a (Continued)

(51) **Int. Cl.**

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G06F 19/00	(2011.01)
H04N 21/4788	(2011.01)

(52) **U.S. Cl.**

CPC ***H04N 7/147*** (2013.01); ***G06F 19/3418*** (2013.01); ***H04N 7/14*** (2013.01); ***H04N 7/142*** (2013.01); ***H04N 21/4788*** (2013.01)

(58) **Field of Classification Search**

CPC H04N 7/14; H04N 7/147; H04N 7/142; H04N 21/4788

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995 A 7/1974 Aghnides
4,107,689 A 8/1978 Jellinek
(Continued)

FOREIGN PATENT DOCUMENTS

AU 1216200 A 5/2000
CA 2289697 A1 11/1998
(Continued)

OTHER PUBLICATIONS

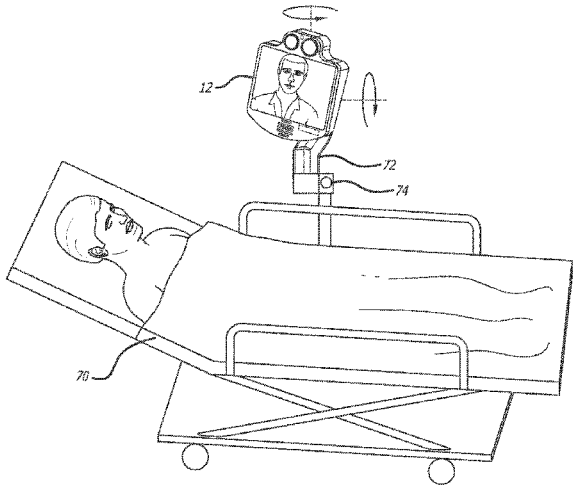
US 8,248,451, 08/2012, Wang et al. (withdrawn)
(Continued)

Primary Examiner — Tuan D Nguyen

(57) **ABSTRACT**

A tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The portable robot face can be attached to a platform mounted to the ceiling of an ambulance. The portable robot face can be used by a physician at the remote station to provide remote medical consultation. When the patient is moved from the ambulance the portable robot face can be detached from the platform and moved with the patient.

4 Claims, 5 Drawing Sheets



Related U.S. Application Data

continuation of application No. 12/548,122, filed on Aug. 26, 2009, now Pat. No. 8,384,755.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,213,182	A	7/1980	Eichelberger et al.
4,413,693	A	11/1983	Derby
4,471,354	A	9/1984	Smith
4,519,466	A	5/1985	Shiraishi
4,553,309	A	11/1985	Hess et al.
4,572,594	A	2/1986	Schwartz
4,625,274	A	11/1986	Schroeder
4,638,445	A	1/1987	Mattaboni
4,652,204	A	3/1987	Arnett
4,669,168	A	6/1987	Tamura et al.
4,679,152	A	7/1987	Perdue
4,697,278	A	9/1987	Fleischer
4,697,472	A	10/1987	Hiyane
4,709,265	A	11/1987	Silverman et al.
4,733,737	A	3/1988	Falamak
4,751,658	A	6/1988	Kadonoff et al.
4,766,581	A	8/1988	Korn et al.
4,777,416	A	10/1988	George, II et al.
4,797,557	A	1/1989	Ohman
4,803,625	A	2/1989	Fu et al.
4,847,764	A	7/1989	Halvorson
4,875,172	A	10/1989	Kanayama
4,878,501	A	11/1989	Shue
4,942,512	A	7/1990	Kohno
4,942,538	A	7/1990	Yuan et al.
4,953,159	A	8/1990	Hayden et al.
4,974,607	A	12/1990	Miwa
4,977,971	A	12/1990	Crane, III et al.
5,006,988	A	4/1991	Borenstein et al.
5,040,116	A	8/1991	Evans, Jr. et al.
5,051,906	A	9/1991	Evans, Jr. et al.
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,130,794	A	7/1992	Ritchey
5,148,591	A	9/1992	Pryor
5,153,833	A	10/1992	Gordon et al.
5,155,684	A	10/1992	Burke et al.
5,157,491	A	10/1992	Kassatly
5,182,641	A	1/1993	Diner et al.
5,186,270	A	2/1993	West
5,193,143	A	3/1993	Kaemmerer et al.
5,217,453	A	6/1993	Wilk
5,220,263	A	6/1993	Onishi et al.
5,224,157	A	6/1993	Yamada et al.
5,230,023	A	7/1993	Nakano
5,231,693	A	7/1993	Backes et al.
5,236,432	A	8/1993	Matsen, III et al.
5,262,944	A	11/1993	Weisner et al.
5,305,427	A	4/1994	Nagata
5,315,287	A	5/1994	Sol
5,319,611	A	6/1994	Korba
5,341,242	A	8/1994	Gilboa et al.
5,341,459	A	8/1994	Backes
5,341,854	A	8/1994	Zezulka et al.
5,347,306	A	9/1994	Nitta
5,347,457	A	9/1994	Tanaka et al.
5,350,033	A	9/1994	Kraft
5,366,896	A	11/1994	Margrey et al.
5,374,879	A	12/1994	Pin et al.
5,375,195	A	12/1994	Johnston
5,400,068	A	3/1995	Ishida et al.
5,413,693	A	5/1995	Redepenning
5,417,210	A	5/1995	Funda et al.
5,419,008	A	5/1995	West
5,436,542	A	7/1995	Petelin et al.
5,441,042	A	8/1995	Putman
5,441,047	A	8/1995	David et al.
5,442,728	A	8/1995	Kaufman et al.
5,462,051	A	10/1995	Oka et al.
5,486,853	A	1/1996	Baxter et al.
5,510,832	A	4/1996	Garcia
5,511,147	A	4/1996	Abdel-Malek
5,528,289	A	6/1996	Cortjens et al.
5,539,741	A	7/1996	Barraclough et al.
5,544,649	A	8/1996	David et al.
5,550,577	A	8/1996	Verbiest et al.
5,553,609	A	9/1996	Chen et al.
5,563,998	A	10/1996	Yaksich et al.
5,572,229	A	11/1996	Fisher
5,572,999	A	11/1996	Funda et al.
5,594,859	A	1/1997	Palmer et al.
5,600,573	A	2/1997	Hendricks et al.
5,617,539	A	4/1997	Ludwig et al.
5,619,341	A	4/1997	Auyeung et al.
5,623,679	A	4/1997	Rivette et al.
5,630,566	A	5/1997	Case
5,636,218	A	6/1997	Ishikawa et al.
5,652,849	A	7/1997	Conway et al.
5,657,246	A	8/1997	Hogan et al.
5,659,779	A	8/1997	Laird et al.
5,673,082	A	9/1997	Wells et al.
5,675,229	A	10/1997	Thorne
5,682,199	A	10/1997	Lankford
5,684,695	A	11/1997	Bauer
5,701,904	A	12/1997	Simmons et al.
5,734,805	A	3/1998	Isensee et al.
5,739,657	A	4/1998	Takayama et al.
5,748,629	A	5/1998	Caldara et al.
5,749,058	A	5/1998	Hashimoto
5,749,362	A	5/1998	Funda et al.
5,754,631	A	5/1998	Cave
5,758,079	A	5/1998	Ludwig et al.
5,762,458	A	6/1998	Wang et al.
5,764,731	A	6/1998	Yablon
5,767,897	A	6/1998	Howell
5,786,846	A	7/1998	Hiroaki
5,787,545	A	8/1998	Colens
5,793,365	A	8/1998	Tang et al.
5,801,755	A	9/1998	Echerer
5,802,494	A	9/1998	Kuno
5,836,872	A	11/1998	Kenet et al.
5,838,575	A	11/1998	Lion
5,844,599	A	12/1998	Hildin
5,857,534	A	1/1999	DeVault et al.
5,867,494	A	2/1999	Krishnaswamy et al.
5,867,653	A	2/1999	Aras et al.
5,871,451	A	2/1999	Unger et al.
5,872,922	A	2/1999	Hogan et al.
5,876,325	A	3/1999	Mizuno et al.
5,911,036	A	6/1999	Wright et al.
5,917,958	A	6/1999	Nunally et al.
5,927,423	A	7/1999	Wada et al.
5,949,758	A	9/1999	Kober
5,954,692	A	9/1999	Smith et al.
5,959,423	A	9/1999	Nakanishi et al.
5,961,446	A	10/1999	Beller et al.
5,966,130	A	10/1999	Benman, Jr.
5,973,724	A	10/1999	Riddle
5,974,446	A	10/1999	Sonnenreich et al.
5,983,263	A	11/1999	Rothrock et al.
5,995,119	A	11/1999	Cosatto et al.
5,995,884	A	11/1999	Allen et al.
5,999,977	A	12/1999	Riddle
6,006,946	A	12/1999	Williams et al.
6,031,845	A	2/2000	Walding
6,036,812	A	3/2000	Williams et al.
6,047,259	A	4/2000	Campbell et al.
6,091,219	A	7/2000	Maruo et al.
6,113,343	A	9/2000	Goldenberg et al.
6,133,944	A	10/2000	Braun et al.
6,135,228	A	10/2000	Asada et al.
6,148,100	A	11/2000	Anderson et al.
6,160,582	A	12/2000	Hill
6,170,929	B1	1/2001	Wilson et al.
6,175,779	B1	1/2001	Barrett
6,189,034	B1	2/2001	Riddle
6,201,984	B1	3/2001	Funda et al.
6,211,903	B1	4/2001	Bullister
6,219,587	B1	4/2001	Ahlin et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,232,735 B1 5/2001 Baba et al.
6,233,504 B1 5/2001 Das et al.
6,233,735 B1 5/2001 Ebihara
6,250,928 B1 6/2001 Poggio et al.
6,256,556 B1 7/2001 Zenke
6,259,806 B1 7/2001 Green
6,259,956 B1 7/2001 Myers et al.
6,266,162 B1 7/2001 Okamura et al.
6,266,577 B1 7/2001 Popp et al.
6,289,263 B1 9/2001 Mukherjee
6,292,713 B1 9/2001 Jouppi et al.
6,292,714 B1 9/2001 Okabayashi
6,304,050 B1 10/2001 Skaar et al.
6,314,631 B1 11/2001 Pryor
6,317,652 B1 11/2001 Osada
6,317,953 B1 11/2001 Pryor
6,321,137 B1 11/2001 De Smet
6,324,184 B1 11/2001 Hou et al.
6,324,443 B1 11/2001 Kurakake et al.
6,325,756 B1 12/2001 Webb et al.
6,327,516 B1 12/2001 Zenke
6,330,486 B1 12/2001 Padula
6,330,493 B1 12/2001 Takahashi et al.
6,346,950 B1 2/2002 Jouppi
6,346,962 B1 2/2002 Goodridge
6,369,847 B1 4/2002 James et al.
6,373,855 B1 4/2002 Downing et al.
6,381,515 B1 4/2002 Inoue et al.
6,389,329 B1 5/2002 Colens
6,400,378 B1 6/2002 Snook
6,408,230 B2 6/2002 Wada
6,411,055 B1 6/2002 Fujita et al.
6,430,471 B1 8/2002 Kintou et al.
6,430,475 B2 8/2002 Okamoto et al.
6,438,457 B1 8/2002 Yokoo et al.
6,445,964 B1 9/2002 White et al.
6,449,762 B1 9/2002 McElvain
6,452,915 B1 9/2002 Jorgensen
6,457,043 B1 9/2002 Kwak et al.
6,459,955 B1 10/2002 Bartsch et al.
6,463,352 B1 10/2002 Tadokoro et al.
6,463,361 B1 10/2002 Wang et al.
6,466,844 B1 10/2002 Ikeda et al.
6,468,265 B1 10/2002 Evans et al.
6,470,235 B2 10/2002 Kasuga et al.
6,474,434 B1 11/2002 Bech
6,480,762 B1 11/2002 Uchikubo et al.
6,491,701 B2 12/2002 Tierney et al.
6,496,099 B2 12/2002 Wang et al.
6,496,755 B2 12/2002 Wallach et al.
6,501,740 B1 12/2002 Sun et al.
6,507,773 B2 1/2003 Parker et al.
6,522,906 B1 2/2003 Salisbury, Jr. et al.
6,523,629 B1 2/2003 Buttz et al.
6,526,332 B2 2/2003 Sakamoto et al.
6,529,620 B2 3/2003 Thompson
6,529,765 B1 3/2003 Franck et al.
6,529,802 B1 3/2003 Kawakita et al.
6,532,404 B2 3/2003 Colens
6,535,182 B2 3/2003 Stanton
6,535,793 B2 3/2003 Allard
6,540,039 B1 4/2003 Yu et al.
6,543,899 B2 4/2003 Covannon et al.
6,549,215 B2 4/2003 Jouppi
6,563,533 B1 5/2003 Colby
6,567,038 B1 5/2003 Granot et al.
6,580,246 B2 6/2003 Jacobs
6,581,798 B2 6/2003 Liff et al.
6,584,376 B1 6/2003 Van Kommer
6,587,750 B2 7/2003 Gerbi et al.
6,590,604 B1 7/2003 Tucker et al.
6,594,269 B1 7/2003 Polcyn
6,594,552 B1 7/2003 Nowlin et al.
6,597,392 B1 7/2003 Jenkins et al.
6,602,469 B1 8/2003 Maus et al.
6,604,019 B2 8/2003 Ahlin et al.
6,604,021 B2 8/2003 Imai et al.
6,611,120 B2 8/2003 Song et al.
6,643,496 B1 11/2003 Shimoyama et al.
6,646,677 B2 11/2003 Noro et al.
6,650,748 B1 11/2003 Edwards et al.
6,666,374 B1 12/2003 Green et al.
6,667,592 B2 12/2003 Jacobs et al.
6,674,259 B1 1/2004 Norman et al.
6,684,129 B2 1/2004 Salisbury, Jr. et al.
6,691,000 B2 2/2004 Nagai et al.
6,693,585 B1 2/2004 MacLeod
6,710,797 B1 3/2004 McNelley et al.
6,724,823 B2 4/2004 Rovati et al.
6,728,599 B2 4/2004 Wright et al.
6,763,282 B2 7/2004 Glenn et al.
6,764,373 B1 7/2004 Osawa et al.
6,769,771 B2 8/2004 Trumbull
6,781,606 B2 8/2004 Jouppi
6,784,916 B2 8/2004 Smith
6,785,589 B2 8/2004 Eggenberger et al.
6,791,550 B2 9/2004 Goldhor et al.
6,798,753 B1 9/2004 Doganata et al.
6,799,065 B1 9/2004 Niemeyer
6,799,088 B2 9/2004 Wang et al.
6,804,580 B1 10/2004 Stoddard et al.
6,804,656 B1 10/2004 Rosenfeld et al.
6,810,411 B1 10/2004 Coughlin et al.
6,816,192 B1 11/2004 Nishikawa
6,816,754 B2 11/2004 Mukai et al.
6,836,703 B2 12/2004 Wang et al.
6,839,612 B2 1/2005 Sanchez et al.
6,840,904 B2 1/2005 Goldberg
6,845,297 B2 1/2005 Allard
6,852,107 B2 2/2005 Wang et al.
6,853,878 B2 2/2005 Hirayama et al.
6,853,880 B2 2/2005 Sakagami et al.
6,871,117 B2 3/2005 Wang et al.
6,879,879 B2 4/2005 Jouppi et al.
6,888,333 B2 5/2005 Laby
6,892,112 B2 5/2005 Wang et al.
6,893,267 B1 5/2005 Yueh
6,895,305 B2 5/2005 Lathan et al.
6,898,484 B2 5/2005 Lemelson et al.
6,914,622 B1 7/2005 Smith et al.
6,925,357 B2 8/2005 Wang et al.
6,951,535 B2 10/2005 Ghodoussi et al.
6,952,470 B1 10/2005 Tioe et al.
6,957,712 B2 10/2005 Song et al.
6,958,706 B2 10/2005 Chaco et al.
6,965,394 B2 11/2005 Gutta et al.
6,990,112 B1 1/2006 Brent et al.
6,995,664 B1 2/2006 Darling
7,007,235 B1 2/2006 Hussein et al.
7,011,538 B2 3/2006 Chang
7,015,934 B2 3/2006 Toyama et al.
RE39,080 E 4/2006 Johnston
7,030,757 B2 4/2006 Matsuhira et al.
7,053,578 B2 5/2006 Diehl et al.
7,055,210 B2 6/2006 Keppler et al.
7,058,689 B2 6/2006 Parker et al.
7,092,001 B2 8/2006 Schulz
7,096,090 B1 8/2006 Zweig
7,115,102 B2 10/2006 Abbruscato
7,117,067 B2 10/2006 McLurkin et al.
7,123,285 B2 10/2006 Smith et al.
7,123,974 B1 10/2006 Hamilton
7,123,991 B2 10/2006 Graf et al.
7,127,325 B2 10/2006 Nagata et al.
7,129,970 B2 10/2006 James et al.
7,133,062 B2 11/2006 Castles et al.
7,142,945 B2 11/2006 Wang et al.
7,142,947 B2 11/2006 Wang et al.
7,151,982 B2 12/2006 Liff et al.
7,154,526 B2 12/2006 Foote et al.
7,155,306 B2 12/2006 Haitin et al.
7,156,809 B2 1/2007 Quy
7,158,859 B2 1/2007 Wang et al.
7,158,860 B2 1/2007 Wang et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,158,861 B2 1/2007 Wang et al.
7,161,322 B2 1/2007 Wang et al.
7,162,338 B2 1/2007 Goncalves et al.
7,164,969 B2 1/2007 Wang et al.
7,164,970 B2 1/2007 Wang et al.
7,167,448 B2 1/2007 Wookey et al.
7,171,286 B2 1/2007 Wang et al.
7,174,238 B1 2/2007 Zweig
7,181,455 B2 2/2007 Wookey et al.
7,184,559 B2 2/2007 Jouppi
7,188,000 B2 3/2007 Chiappetta et al.
7,199,790 B2 4/2007 Rosenberg et al.
7,202,851 B2 4/2007 Cunningham et al.
7,206,627 B2 4/2007 Abovitz et al.
7,215,786 B2 5/2007 Nakadai et al.
7,219,364 B2 5/2007 Bolle et al.
7,222,000 B2 5/2007 Wang et al.
7,227,334 B2 6/2007 Yang et al.
7,256,708 B2 8/2007 Rosenfeld et al.
7,262,573 B2 8/2007 Wang et al.
7,283,153 B2 10/2007 Provost et al.
7,289,883 B2 10/2007 Wang et al.
7,292,257 B2 11/2007 Kang et al.
7,292,912 B2 11/2007 Wang et al.
7,305,114 B2 12/2007 Wolff et al.
7,317,685 B1 1/2008 Flott et al.
7,321,807 B2 1/2008 Laski
7,332,890 B2 2/2008 Cohen et al.
7,333,642 B2 2/2008 Green
7,346,429 B2 3/2008 Goldenberg et al.
7,352,153 B2 4/2008 Yan
7,363,121 B1 4/2008 Chen et al.
7,382,399 B1 6/2008 McCall et al.
7,386,730 B2 6/2008 Uchikubo
7,391,432 B2 6/2008 Terada
7,400,578 B2 7/2008 Guthrie et al.
7,404,140 B2 7/2008 O'rourke
7,421,470 B2 9/2008 Ludwig et al.
7,430,209 B2 9/2008 Porter
7,432,949 B2 10/2008 Remy et al.
7,433,921 B2 10/2008 Ludwig et al.
7,441,953 B2 10/2008 Banks
7,467,211 B1 12/2008 Herman et al.
7,483,867 B2 1/2009 Ansari et al.
7,492,731 B2 2/2009 Hagendorf
7,510,428 B2 3/2009 Obata et al.
7,523,069 B1 4/2009 Friedl et al.
7,525,281 B2 4/2009 Koyanagi et al.
7,535,486 B2 5/2009 Motomura et al.
7,557,758 B2 7/2009 Rofougaran
7,587,260 B2 9/2009 Bruemmer et al.
7,587,512 B2 9/2009 Ta et al.
7,590,060 B2 9/2009 Miceli
7,593,030 B2 9/2009 Wang et al.
7,599,290 B2 10/2009 Dos Remedios et al.
7,624,166 B2 11/2009 Foote et al.
7,630,314 B2 12/2009 Dos Remedios et al.
7,631,833 B1 12/2009 Ghaleb et al.
7,643,051 B2 1/2010 Sandberg et al.
7,647,320 B2 1/2010 Mok et al.
7,657,560 B1 2/2010 DiRienzo
7,680,038 B1 3/2010 Gourlay
7,693,757 B2 4/2010 Zimmerman
7,698,432 B2 4/2010 Short et al.
7,703,113 B2 4/2010 Dawson
7,719,229 B2 5/2010 Kaneko et al.
7,737,993 B2 6/2010 Kaasila et al.
7,739,383 B1 6/2010 Short et al.
7,756,614 B2 7/2010 Jouppi
7,761,185 B2 7/2010 Wang et al.
7,769,492 B2 8/2010 Wang et al.
7,769,705 B1 8/2010 Luechtefeld
7,774,158 B2 8/2010 Domingues et al.
7,813,836 B2 10/2010 Wang et al.
7,831,575 B2 11/2010 Trossell et al.
7,835,775 B2 11/2010 Sawayama et al.
7,860,680 B2 12/2010 Arms et al.
7,861,366 B2 1/2011 Hahm et al.
7,885,822 B2 2/2011 Akers et al.
7,890,382 B2 2/2011 Robb et al.
7,912,583 B2 3/2011 Gutmann et al.
RE42,288 E 4/2011 Degioanni
7,924,323 B2 4/2011 Walker et al.
7,949,616 B2 5/2011 Levy et al.
7,956,894 B2 6/2011 Akers et al.
7,957,837 B2 6/2011 Ziegler et al.
7,982,763 B2 7/2011 King
7,982,769 B2 7/2011 Jenkins et al.
7,987,069 B2 7/2011 Rodgers et al.
8,077,963 B2 12/2011 Wang et al.
8,116,910 B2 2/2012 Walters et al.
8,126,960 B2 2/2012 Obradovich et al.
8,170,241 B2 5/2012 Roe et al.
8,179,418 B2 5/2012 Wright et al.
8,180,486 B2 5/2012 Saito et al.
8,209,051 B2 6/2012 Wang et al.
8,212,533 B2 7/2012 Ota
8,265,793 B2 9/2012 Cross et al.
8,287,522 B2 10/2012 Moses et al.
8,292,807 B2 10/2012 Perkins et al.
8,320,534 B2 11/2012 Kim et al.
8,340,654 B2 12/2012 Bratton et al.
8,340,819 B2 12/2012 Mangaser et al.
8,348,675 B2 1/2013 Dohrmann
8,374,171 B2 2/2013 Cho et al.
8,384,755 B2 2/2013 Wang et al.
8,400,491 B1 3/2013 Panpaliya et al.
8,401,275 B2 3/2013 Wang et al.
8,423,284 B2 4/2013 O'Shea
8,451,731 B1 5/2013 Lee et al.
8,463,435 B2 6/2013 Herzog et al.
8,503,340 B1 8/2013 Xu
8,515,577 B2 8/2013 Wang et al.
8,527,094 B2 9/2013 Kumar et al.
8,532,860 B2 9/2013 Daly
8,610,786 B2 12/2013 Ortiz
8,612,051 B2 12/2013 Norman et al.
8,639,797 B1 1/2014 Pan et al.
8,670,017 B2 3/2014 Stuart et al.
8,726,454 B2 5/2014 Gilbert, Jr. et al.
8,780,165 B2 7/2014 Wang et al.
8,836,751 B2 9/2014 Ballantyne et al.
8,849,679 B2 9/2014 Wang et al.
8,849,680 B2 9/2014 Wright et al.
8,861,750 B2 10/2014 Roe et al.
8,897,920 B2 11/2014 Wang et al.
8,902,278 B2 12/2014 Pinter et al.
2001/0002448 A1 5/2001 Wilson et al.
2001/0010053 A1 7/2001 Ben-Shachar et al.
2001/0020200 A1 9/2001 Das et al.
2001/0034475 A1 10/2001 Flach et al.
2001/0034544 A1 10/2001 Mo
2001/0037163 A1 11/2001 Allard
2001/0048464 A1 12/2001 Barnett
2001/0051881 A1 12/2001 Filler
2001/0054071 A1 12/2001 Loeb
2001/0055373 A1 12/2001 Yamashita
2002/0015296 A1 2/2002 Howell et al.
2002/0027597 A1 3/2002 Sachau
2002/0027652 A1 3/2002 Paromtchik et al.
2002/0033880 A1 3/2002 Sul et al.
2002/0038168 A1 3/2002 Kasuga et al.
2002/0044201 A1 4/2002 Alexander et al.
2002/0049517 A1 4/2002 Ruffner
2002/0055917 A1 5/2002 Muraca
2002/0057279 A1 5/2002 Jouppi
2002/0058929 A1 5/2002 Green
2002/0059587 A1 5/2002 Cofano et al.
2002/0063726 A1 5/2002 Jouppi
2002/0073429 A1 6/2002 Beane et al.
2002/0082498 A1 6/2002 Wendt et al.
2002/0085030 A1 7/2002 Ghani
2002/0095238 A1 7/2002 Ahlin et al.
2002/0095239 A1 7/2002 Wallach et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0098879 A1 7/2002 Rheey
2002/0104094 A1 8/2002 Alexander et al.
2002/0106998 A1 8/2002 Presley et al.
2002/0109770 A1 8/2002 Terada
2002/0109775 A1 8/2002 White et al.
2002/0111988 A1 8/2002 Sato
2002/0120362 A1 8/2002 Lathan et al.
2002/0128985 A1 9/2002 Greenwald
2002/0130950 A1 9/2002 James et al.
2002/0133062 A1 9/2002 Arling et al.
2002/0141595 A1 10/2002 Jouppi
2002/0143923 A1 10/2002 Alexander
2002/0177925 A1 11/2002 Onishi et al.
2002/0183894 A1 12/2002 Wang et al.
2002/0184674 A1 12/2002 Xi et al.
2002/0186243 A1 12/2002 Ellis et al.
2003/0021107 A1 1/2003 Howell et al.
2003/0030397 A1 2/2003 Simmons
2003/0048481 A1 3/2003 Kobayashi et al.
2003/0050733 A1 3/2003 Wang et al.
2003/0050734 A1 3/2003 Lapham
2003/0060808 A1 3/2003 Wilk
2003/0063600 A1 4/2003 Noma et al.
2003/0069752 A1 4/2003 Ledain et al.
2003/0080901 A1 5/2003 Piotrowski
2003/0100892 A1 5/2003 Morley et al.
2003/0104806 A1 6/2003 Ruef et al.
2003/0112823 A1 6/2003 Collins et al.
2003/0114962 A1 6/2003 Niemeyer et al.
2003/0120714 A1 6/2003 Wolff et al.
2003/0126361 A1 7/2003 Slater et al.
2003/0135097 A1 7/2003 Wiederhold et al.
2003/0135203 A1 7/2003 Wang et al.
2003/0144579 A1 7/2003 Buss
2003/0144649 A1 7/2003 Ghodoussi et al.
2003/0151658 A1 8/2003 Smith
2003/0152145 A1 8/2003 Kawakita
2003/0171710 A1 9/2003 Bassuk et al.
2003/0174285 A1 9/2003 Trumbull
2003/0180697 A1 9/2003 Kim et al.
2003/0195662 A1 10/2003 Wang et al.
2003/0199000 A1 10/2003 Valkirs et al.
2003/0206242 A1 11/2003 Choi
2003/0212472 A1 11/2003 McKee
2003/0216833 A1 11/2003 Mukai et al.
2003/0216834 A1 11/2003 Allard
2003/0220541 A1 11/2003 Salisbury, Jr. et al.
2003/0220715 A1 11/2003 Kneifel, II et al.
2003/0231244 A1 12/2003 Bonilla et al.
2003/0232649 A1 12/2003 Gizis et al.
2003/0236590 A1 12/2003 Park et al.
2004/0001197 A1 1/2004 Ko et al.
2004/0001676 A1 1/2004 Colgan et al.
2004/0008138 A1 1/2004 Hockley, Jr. et al.
2004/0010344 A1 1/2004 Hiratsuka et al.
2004/0012362 A1 1/2004 Tsurumi
2004/0013295 A1 1/2004 Sabe et al.
2004/0017475 A1 1/2004 Akers et al.
2004/0019406 A1 1/2004 Wang et al.
2004/0024490 A1 2/2004 McLurkin et al.
2004/0041904 A1 3/2004 Lapalme et al.
2004/0065073 A1 4/2004 Nash
2004/0068657 A1 4/2004 Alexander et al.
2004/0078219 A1 4/2004 Kaylor et al.
2004/0080610 A1 4/2004 James et al.
2004/0088077 A1 5/2004 Jouppi et al.
2004/0088078 A1 5/2004 Jouppi et al.
2004/0093409 A1 5/2004 Thompson et al.
2004/0095516 A1 5/2004 Rohlicek
2004/0098167 A1 5/2004 Yi et al.
2004/0102167 A1 5/2004 Shim et al.
2004/0107254 A1 6/2004 Ludwig et al.
2004/0107255 A1 6/2004 Ludwig et al.
2004/0117065 A1 6/2004 Wang et al.
2004/0117067 A1 6/2004 Jouppi
2004/0123158 A1 6/2004 Roskind
2004/0135879 A1 7/2004 Stacy et al.
2004/0138547 A1 7/2004 Wang et al.
2004/0143421 A1 7/2004 Wang et al.
2004/0148638 A1 7/2004 Weisman et al.
2004/0150725 A1 8/2004 Taguchi
2004/0153211 A1 8/2004 Kamoto et al.
2004/0157612 A1 8/2004 Kim
2004/0162637 A1 8/2004 Wang et al.
2004/0167666 A1 8/2004 Wang et al.
2004/0167668 A1 8/2004 Wang et al.
2004/0168148 A1 8/2004 Goncalves et al.
2004/0170300 A1 9/2004 Jouppi
2004/0172301 A1 9/2004 Mihai et al.
2004/0172306 A1 9/2004 Wohl et al.
2004/0174129 A1 9/2004 Wang et al.
2004/0175684 A1 9/2004 Kaasa et al.
2004/0179714 A1 9/2004 Jouppi
2004/0186623 A1 9/2004 Dooley et al.
2004/0189700 A1 9/2004 Mandavilli et al.
2004/0201602 A1 10/2004 Mody et al.
2004/0205664 A1 10/2004 Prendergast
2004/0215490 A1 10/2004 Duchon et al.
2004/0218099 A1 11/2004 Washington
2004/0222638 A1 11/2004 Bednyak
2004/0224676 A1 11/2004 Iseki
2004/0230340 A1 11/2004 Fukuchi et al.
2004/0240981 A1 12/2004 Dothan et al.
2004/0241981 A1 12/2004 Doris et al.
2004/0260790 A1 12/2004 Balloni et al.
2005/0003330 A1 1/2005 Asgarinejad et al.
2005/0004708 A1 1/2005 Goldenberg et al.
2005/0007445 A1 1/2005 Foote et al.
2005/0013149 A1 1/2005 Trossell
2005/0021182 A1 1/2005 Wang et al.
2005/0021183 A1 1/2005 Wang et al.
2005/0021187 A1 1/2005 Wang et al.
2005/0021309 A1 1/2005 Alexander et al.
2005/0024485 A1 2/2005 Castles et al.
2005/0027567 A1 2/2005 Taha
2005/0027794 A1 2/2005 Decker
2005/0028221 A1 2/2005 Liu et al.
2005/0035862 A1 2/2005 Wildman et al.
2005/0038416 A1 2/2005 Wang et al.
2005/0038564 A1 2/2005 Burick
2005/0049898 A1 3/2005 Hirakawa
2005/0052527 A1 3/2005 Remy et al.
2005/0060211 A1 3/2005 Xiao et al.
2005/0065435 A1 3/2005 Rauch et al.
2005/0065438 A1 3/2005 Miller
2005/0065659 A1 3/2005 Tanaka et al.
2005/0065813 A1 3/2005 Mishelevich et al.
2005/0071046 A1 3/2005 Miyazaki et al.
2005/0073575 A1 4/2005 Thacher et al.
2005/0078816 A1 4/2005 Sekiguchi et al.
2005/0083011 A1 4/2005 Yang et al.
2005/0099493 A1 5/2005 Chew
2005/0104964 A1 5/2005 Bovyrin et al.
2005/0110867 A1 5/2005 Schulz
2005/0122390 A1 6/2005 Wang et al.
2005/0125083 A1 6/2005 Kiko
2005/0125098 A1 6/2005 Wang et al.
2005/0149364 A1 7/2005 Ombrellaro
2005/0152447 A1 7/2005 Jouppi et al.
2005/0152565 A1 7/2005 Jouppi et al.
2005/0154265 A1 7/2005 Miro et al.
2005/0168568 A1 8/2005 Jouppi
2005/0182322 A1 8/2005 Grispo
2005/0192721 A1 9/2005 Jouppi
2005/0204438 A1 9/2005 Wang et al.
2005/0212478 A1 9/2005 Takenaka
2005/0219356 A1 10/2005 Smith et al.
2005/0225634 A1 10/2005 Brunetti et al.
2005/0231156 A1 10/2005 Yan
2005/0231586 A1 10/2005 Rodman et al.
2005/0232647 A1 10/2005 Takenaka
2005/0234592 A1 10/2005 McGee et al.
2005/0264649 A1 12/2005 Chang et al.
2005/0267826 A1 12/2005 Levy et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0283414 A1 12/2005 Fernandes et al.
2005/0286759 A1 12/2005 Zitnick et al.
2006/0007943 A1 1/2006 Fellman
2006/0010028 A1 1/2006 Sorensen
2006/0013263 A1 1/2006 Fellman
2006/0013469 A1 1/2006 Wang et al.
2006/0013488 A1 1/2006 Inoue
2006/0014388 A1 1/2006 Lur et al.
2006/0020694 A1 1/2006 Nag et al.
2006/0029065 A1 2/2006 Fellman
2006/0047365 A1 3/2006 Ghodoussi et al.
2006/0048286 A1 3/2006 Donato
2006/0052676 A1 3/2006 Wang et al.
2006/0052684 A1 3/2006 Takahashi et al.
2006/0056655 A1 3/2006 Wen et al.
2006/0056837 A1 3/2006 Vapaakoski
2006/0064212 A1 3/2006 Thorne
2006/0066609 A1 3/2006 Iodice et al.
2006/0071797 A1 4/2006 Rosenfeld et al.
2006/0074525 A1 4/2006 Close et al.
2006/0074719 A1 4/2006 Horner
2006/0082642 A1 4/2006 Wang et al.
2006/0087746 A1 4/2006 Lipow
2006/0095158 A1 5/2006 Lee et al.
2006/0095170 A1 5/2006 Yang et al.
2006/0098573 A1 5/2006 Beer et al.
2006/0103659 A1 5/2006 Karandikar et al.
2006/0104279 A1 5/2006 Fellman et al.
2006/0106493 A1 5/2006 Niemeyer et al.
2006/0122482 A1 6/2006 Mariotti et al.
2006/0125356 A1 6/2006 Meek, Jr. et al.
2006/0142983 A1 6/2006 Sorensen et al.
2006/0149418 A1 7/2006 Anvari
2006/0161136 A1 7/2006 Anderson et al.
2006/0161303 A1 7/2006 Wang et al.
2006/0164546 A1 7/2006 Adachi
2006/0171515 A1 8/2006 Hintermeister et al.
2006/0173708 A1 8/2006 Vining et al.
2006/0173712 A1 8/2006 Joubert
2006/0178559 A1 8/2006 Kumar et al.
2006/0178776 A1 8/2006 Feingold et al.
2006/0178777 A1 8/2006 Park et al.
2006/0189393 A1 8/2006 Edery
2006/0195569 A1 8/2006 Barker
2006/0224781 A1 10/2006 Tsao et al.
2006/0247045 A1 11/2006 Jeong et al.
2006/0259193 A1 11/2006 Wang et al.
2006/0268704 A1 11/2006 Ansari et al.
2006/0271238 A1 11/2006 Choi et al.
2006/0271400 A1 11/2006 Clements et al.
2006/0293788 A1 12/2006 Pogodin
2007/0021871 A1 1/2007 Wang et al.
2007/0025711 A1 2/2007 Marcus
2007/0046237 A1 3/2007 Lakshmanan et al.
2007/0050937 A1 3/2007 Song et al.
2007/0064092 A1 3/2007 Sandberg et al.
2007/0078566 A1 4/2007 Wang et al.
2007/0093279 A1 4/2007 Janik
2007/0112700 A1 5/2007 Den et al.
2007/0116152 A1 5/2007 Thesling
2007/0117516 A1 5/2007 Saidi et al.
2007/0120965 A1 5/2007 Sandberg et al.
2007/0122783 A1 5/2007 Habashi
2007/0133407 A1 6/2007 Choi et al.
2007/0135967 A1 6/2007 Jung et al.
2007/0142964 A1 6/2007 Abramson
2007/0170886 A1 7/2007 Plishner
2007/0176060 A1 8/2007 White et al.
2007/0192910 A1 8/2007 Vu et al.
2007/0197896 A1 8/2007 Moll et al.
2007/0198128 A1 8/2007 Ziegler et al.
2007/0198130 A1 8/2007 Wang et al.
2007/0199108 A1 8/2007 Angle et al.
2007/0216347 A1 9/2007 Kaneko et al.
2007/0226949 A1 10/2007 Hahm et al.
2007/0250212 A1 10/2007 Halloran et al.
2007/0255706 A1 11/2007 Iketani et al.
2007/0262884 A1 11/2007 Goncalves et al.
2007/0273751 A1 11/2007 Sachau
2007/0290040 A1 12/2007 Wurman et al.
2007/0291109 A1 12/2007 Wang et al.
2007/0291128 A1 12/2007 Wang et al.
2008/0009969 A1 1/2008 Bruemmer et al.
2008/0011904 A1 1/2008 Cepollina et al.
2008/0027591 A1 1/2008 Lenser et al.
2008/0033641 A1 2/2008 Medalia
2008/0045804 A1 2/2008 Williams
2008/0051985 A1 2/2008 D'Andrea et al.
2008/0065268 A1 3/2008 Wang et al.
2008/0082211 A1 4/2008 Wang et al.
2008/0086241 A1 4/2008 Phillips et al.
2008/0091340 A1 4/2008 Milstein et al.
2008/0126132 A1 5/2008 Warner et al.
2008/0133052 A1 6/2008 Jones et al.
2008/0161969 A1 7/2008 Lee et al.
2008/0174570 A1 7/2008 Jobs et al.
2008/0201016 A1 8/2008 Finlay
2008/0201017 A1 8/2008 Wang et al.
2008/0215987 A1 9/2008 Alexander et al.
2008/0229531 A1 9/2008 Takida
2008/0232763 A1 9/2008 Brady
2008/0255703 A1 10/2008 Wang et al.
2008/0263451 A1 10/2008 Portele et al.
2008/0263628 A1 10/2008 Norman et al.
2008/0267069 A1 10/2008 Thielman et al.
2008/0269949 A1 10/2008 Norman et al.
2008/0281467 A1 11/2008 Pinter
2008/0306375 A1 12/2008 Sayler et al.
2009/0030552 A1 1/2009 Nakadai et al.
2009/0044334 A1 2/2009 Parsell et al.
2009/0049640 A1 2/2009 Lee et al.
2009/0055023 A1 2/2009 Walters et al.
2009/0070135 A1 3/2009 Parida et al.
2009/0086013 A1 4/2009 Thapa
2009/0102919 A1 4/2009 Zamierowski et al.
2009/0105882 A1 4/2009 Wang et al.
2009/0106679 A1 4/2009 Anzures et al.
2009/0122699 A1 5/2009 Alperovitch et al.
2009/0125147 A1 5/2009 Wang et al.
2009/0144425 A1 6/2009 Marr et al.
2009/0164255 A1 6/2009 Menschik et al.
2009/0164657 A1 6/2009 Li et al.
2009/0171170 A1 7/2009 Li et al.
2009/0177323 A1 7/2009 Ziegler et al.
2009/0177641 A1 7/2009 Raghavan
2009/0237317 A1 9/2009 Rofougaran
2009/0240371 A1 9/2009 Wang et al.
2009/0248200 A1 10/2009 Root
2009/0259339 A1 10/2009 Wright et al.
2010/0010672 A1 1/2010 Wang et al.
2010/0010673 A1 1/2010 Wang et al.
2010/0017046 A1 1/2010 Cheung et al.
2010/0019715 A1 1/2010 Roe et al.
2010/0026239 A1 2/2010 Li et al.
2010/0030578 A1 2/2010 Siddique et al.
2010/0051596 A1 3/2010 Diedrick et al.
2010/0063848 A1 3/2010 Kremer et al.
2010/0066804 A1 3/2010 Shoemake et al.
2010/0070079 A1 3/2010 Mangaser et al.
2010/0073490 A1 3/2010 Wang et al.
2010/0076600 A1 3/2010 Cross et al.
2010/0085874 A1 4/2010 Noy et al.
2010/0088232 A1 4/2010 Gale
2010/0115418 A1 5/2010 Wang et al.
2010/0116566 A1 5/2010 Ohm et al.
2010/0131103 A1 5/2010 Herzog et al.
2010/0145479 A1 6/2010 Griffiths
2010/0157825 A1 6/2010 Anderlind et al.
2010/0171826 A1 7/2010 Hamilton et al.
2010/0191375 A1 7/2010 Wright et al.
2010/0228249 A1 9/2010 Mohr et al.
2010/0268383 A1 10/2010 Wang et al.
2010/0278086 A1 11/2010 Pochiraju et al.
2010/0286905 A1 11/2010 Goncalves et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0301679	A1	12/2010	Murray et al.
2010/0323783	A1	12/2010	Nonaka et al.
2011/0022705	A1	1/2011	Yellamraju et al.
2011/0050841	A1	3/2011	Wang et al.
2011/0071675	A1	3/2011	Wells et al.
2011/0071702	A1	3/2011	Wang et al.
2011/0072114	A1	3/2011	Hoffert et al.
2011/0153198	A1	6/2011	Kokkas et al.
2011/0172822	A1	7/2011	Ziegler et al.
2011/0187875	A1	8/2011	Sanchez et al.
2011/0190930	A1	8/2011	Hanrahan et al.
2011/0193949	A1	8/2011	Nambakam et al.
2011/0195701	A1	8/2011	Cook et al.
2011/0213210	A1	9/2011	Temby et al.
2011/0218674	A1	9/2011	Stuart et al.
2011/0245973	A1	10/2011	Wang et al.
2011/0280551	A1	11/2011	Sammon
2011/0292193	A1	12/2011	Wang et al.
2011/0301759	A1	12/2011	Wang et al.
2011/0306400	A1	12/2011	Nguyen
2012/0023506	A1	1/2012	Maeckel et al.
2012/0036484	A1	2/2012	Zhang et al.
2012/0059946	A1	3/2012	Wang
2012/0072023	A1	3/2012	Ota
2012/0072024	A1	3/2012	Wang et al.
2012/0092157	A1	4/2012	Tran
2012/0095352	A1	4/2012	Tran
2012/0113856	A1	5/2012	Krishnaswamy
2012/0191246	A1	7/2012	Roe et al.
2012/0191464	A1	7/2012	Stuart et al.
2012/0203731	A1	8/2012	Nelson et al.
2012/0291809	A1	11/2012	Kuhe et al.
2013/0250938	A1	9/2013	Anandakumar et al.
2014/0047022	A1	2/2014	Chan et al.
2014/0085543	A1	3/2014	Hartley et al.
2014/0135990	A1	5/2014	Stuart et al.
2014/0139616	A1	5/2014	Pinter et al.
2014/0155755	A1	6/2014	Pinter et al.
2014/0267552	A1	9/2014	Wang et al.

FOREIGN PATENT DOCUMENTS

CN	1404695	A	3/2003
CN	1554193	A	12/2004
CN	1554985	A	12/2004
CN	1561923	A	1/2005
CN	1743144	A	3/2006
CN	101049017	A	10/2007
CN	101106939	A	1/2008
CN	101151614	A	3/2008
CN	100407729	A	7/2008
CN	101390098	A	3/2009
CN	101507260	A	8/2009
CN	101730894	A	6/2010
CN	101866396	A	10/2010
CN	101978365	A	2/2011
CN	102203759	A	9/2011
CN	101106939	B	11/2011
EP	466492	A2	1/1992
EP	488673	A2	6/1992
EP	981905	B1	1/2002
EP	1262142	A2	12/2002
EP	1304872	A1	4/2003
EP	1536660	A2	6/2005
EP	1573406	A2	9/2005
EP	1594660	A2	11/2005
EP	1763243	A2	3/2007
EP	1791464	A2	6/2007
EP	1800476	A2	6/2007
EP	1819108	A2	8/2007
EP	1856644	A2	11/2007
EP	1536660	A3	4/2008
EP	1928310	A2	6/2008
EP	1232610	B1	1/2009
EP	2027716	A2	2/2009
EP	2145274	A1	1/2010
EP	2214111	A2	8/2010
EP	2263158	A2	12/2010
EP	2300930	A1	3/2011
EP	2342651	A1	7/2011
GB	2431261	A	4/2007
JP	07-194609	A	8/1995
JP	7-213753	A	8/1995
JP	7-248823	A	9/1995
JP	7-257422	A	10/1995
JP	8-84328	A	3/1996
JP	8-320727	A	12/1996
JP	9-267276	A	10/1997
JP	10-79097	A	3/1998
JP	10-288689	A	10/1998
JP	11-220706	A	8/1999
JP	2000-32319	A	1/2000
JP	2000-49800	A	2/2000
JP	2000-79587	A	3/2000
JP	2000-196876	A	7/2000
JP	2001-88124	A	4/2001
JP	2001-125641	A	5/2001
JP	2001-147718	A	5/2001
JP	2001-179663	A	7/2001
JP	2001-188124	A	7/2001
JP	2001-198865	A	7/2001
JP	2001-198868	A	7/2001
JP	2001-199356	A	7/2001
JP	2002-000574	A	1/2002
JP	2002-35423	A	2/2002
JP	2002-46088	A	2/2002
JP	2002-101333	A	4/2002
JP	2002-112970	A	4/2002
JP	2002-235423	A	8/2002
JP	2002-305743	A	10/2002
JP	2002-321180	A	11/2002
JP	2002-355779	A	12/2002
JP	2004-181229	A	7/2004
JP	2004-524824	T	8/2004
JP	2004-261941	A	9/2004
JP	2004-289379	A	10/2004
JP	2005-028066	A	2/2005
JP	2005-059170	A	3/2005
JP	2005-111083	A	4/2005
JP	2006-508806	A	3/2006
JP	2006-109094	A	4/2006
JP	2006-224294	A	8/2006
JP	2006-246438	A	9/2006
JP	2007-7040	A	1/2007
JP	2007-81646	A	3/2007
JP	2007-232208	A	9/2007
JP	2007-316966	A	12/2007
JP	2009-125133	A	6/2009
JP	2010-064154	A	3/2010
JP	2010-532109	A	9/2010
JP	2010-246954	A	11/2010
KR	10-2006-0037979	A	5/2006
KR	10-2009-0012542	A	2/2009
KR	10-2010-0019479	A	2/2010
KR	10-2010-0139037	A	12/2010
WO	93/06690	A1	4/1993
WO	97/42761	A1	11/1997
WO	98/51078	A1	11/1998
WO	99/67067	A1	12/1999
WO	00/25516	A1	5/2000
WO	00/33726	A1	6/2000
WO	01/31861	A1	5/2001
WO	03/077745	A1	9/2003
WO	2004/008738	A1	1/2004
WO	2004/012018	A2	2/2004
WO	20041075456	A2	9/2004
WO	2006/012797	A1	2/2006
WO	2006/044847	A2	4/2006
WO	2006/078611	A2	7/2006
WO	2007/041295	A2	4/2007
WO	2007/041038	A3	6/2007
WO	2008/100272	A2	8/2008
WO	2008/100272	A3	10/2008
WO	2009/117274	A2	9/2009

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	2009/128997	A1	10/2009
WO	2009/145958	A2	12/2009
WO	2010/006205	A1	1/2010
WO	2010/006211	A1	1/2010
WO	2010/033666	A1	3/2010
WO	2010/047881	A1	4/2010
WO	2010/062798	A1	6/2010
WO	2010/065257	A1	6/2010
WO	2010/120407	A1	10/2010
WO	2011/028589	A2	3/2011
WO	2011/028589	A3	4/2011
WO	2011/097130	A2	8/2011
WO	2011/097132	A2	8/2011
WO	2011/109336	A2	9/2011
WO	2011/097132	A3	12/2011
WO	2011/149902	A2	12/2011

OTHER PUBLICATIONS

Harmo et al., "Moving Eye—Interactive Telepresence over Internet with a Ball Shaped Mobile Robot", Automation Technology Laboratory, Helsinki University of Technology, 2000, 6 pages.

Haule et al., "Control Scheme for Delayed Teleoperation Tasks", Communications, Computers and Signal Processing, Proceedings of IEEE Pacific Rim Conference, May 17-19, 1995, pp. 157-160.

Hees, William P., "Communications Design for a Remote Presence Robot", CSCI E-131B, Final Project, Jan. 14, 2002, 12 pages.

Herias et al., "Flexible Virtual and Remote Laboratory for Teaching Robotics", FORMATEX 2006, Proceedings of Advance in Control Education Madrid, Spain, Jun. 2006, pp. 1959-1963.

Holmberg et al., "Development of a Holonomic Mobile Robot for Mobile Manipulation Tasks", FSR'99 International Conference on Field and Service Robotics, Pittsburgh, PA, Aug. 1999, 6 pages.

Ishiguro et al., "Integrating a Perceptual Information Infrastructure with Robotic Avatars: A Framework for Tele-Existence", Intelligent Robots and Systems, Proceedings of 1999 IEEE/RSJ International Conference, vol. 2, 1999, pp. 1032-1038.

Ishihara et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Proceedings of IEEE/RSJ International Workshop on Intelligent Robots and Systems, vol. 2, Nov. 3-5, 1991, pp. 1145-1150.

ITU, "Call Completion Supplementary Services for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.9, Series H: Audiovisual and Multimedia Systems, Nov. 2000, 63 pages.

ITU, "Call Intrusion Supplementary Service for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.11, Series H: Audiovisual and Multimedia Systems, Mar. 2001, 59 pages.

ITU, "Packet-Based Multimedia Communications Systems", ITU-T, Telecommunication Standardization Sector of ITU, H.323, Series H: Audiovisual and Multimedia Systems, Feb. 1998, 128 pages.

ITU, "A Far End Camera Control Protocol for Videoconferences Using H.224", Transmission of Non-Telephone . Signals, ITU-T, Telecommunication Standardization Sector of ITU, H.281, Nov. 1994, 12 pages.

Ivanova, Natali, "Internet Based Interface for Control of a Mobile Robot", First Degree Programme in Mathematics and Computer Science, Master•s thesis, Department of Numerical Analysis and Computer Science, 2003, 59 pages.

Jacobs et al., "Applying Telemedicine to Outpatient Physical Therapy", AMIA, Annual Symposium Proceedings, 2002, 1 page.

Jenkins et al., "Telehealth Advancing Nursing Practice", Nursing Outlook, vol. 49, No. 2, Mar. 2001, pp. 100-105.

Johanson, Mathias, "Supporting Video-Mediated Communication over the Internet", Thesis for the degree of Doctor of Philosophy, Department of Computer Engineering, Chalmers University of Technology, Gothenburg, Sweden, 2003, 222 pages.

Jouppi et al., "BiReality: Mutually-Immersive Telepresence", Multimedia '04, Proceedings of the 12th Annual ACM International Conference on Multimedia, Oct. 10-16, 2004, pp. 860-867.

Jouppi et al., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Proceedings of the ACM conference on Computer Supported Cooperative Work, Nov. 16-20, 2002, pp. 354-363.

Kanehiro et al., "Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting", Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, Oct. 29-Nov. 3, 2001, pp. 1093-1099.

Kaplan et al., "An Internet Accessible Telepresence", Multimedia Systems Journal, vol. 5, 1996, 7 pages.

Keller et al., "An Interface for Raven", The National Aviary's Teleconferencing Robot, Interaction and Visual Interface Design, School of Design, Carnegie Mellon University, 2001, 8 pages.

Khatib et al., "Robots in Human Environments", Robotics Laboratory, Department of Computer Science, Stanford University, 1999, 15 pages.

Knight et al., "Active Visual Alignment of a Mobile Stereo Camera Platform", Robotics and Automation, Proceedings of ICRA '00, IEEE International Conference, vol. 4, Apr. 24-28, 2000, pp. 3203-3208.

Kurlowicz et al., "The Mini Mental State Examination (MMSE)", The Hartford Institute for Geriatric Nursing, Journal of Psychiatric Research, No. 3, Jan. 1999, 2 pages.

Kuzuoka et al., "Can the GestureCam be a Surrogate?", Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work, Sep. 10-14, 1995, pp. 181-196.

Lane, Earl, "Automated Aides", available online at <http://www.cs.cum.edu/nursebot/web/press/nd4380.htm>, Reterieved on Nov. 23, 2010, Oct. 17, 2000, 4 pages.

Lee et al., "A Novel Method of Surgical Instruction: International Telementoring", World Journal of Urology, vol. 16, No. 6, Dec. 1998, pp. 367-370.

Lemaire, Edward, "Using Communication Technology to Enhance Rehabilitation Services", Terry Fox Mobile Clinic, The Rehabilitation Centre, Ottawa, Canada, Version 2.0, 1998-2001, 104 pages.

Lim et al., "Control to Realize Human-Like Walking of a Biped Humanoid Robot", Systems, Man and Cybernetics, IEEE International Conference, vol. 5, 2000, pp. 3271-3276.

Linebarger et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Department of Computer Science and Engineering; Lehigh University, vol. 13, 2004, 40 pages.

Sachs et al., "Virtual Visit™: Improving Communication for Those Who Need it Most", Studies in Health Technology and Informatics, vol. 94, Medicine Meets Virtual Reality 11, 2003, pp. 302-308.

Long, William F., "Robot Navigation Technology", available online at <http://www.atp.nist.gov/eao/sp950-1/helpmate.htm>, retrieved on Nov. 23, 2010, Mar. 1999, 3 pages.

Luna, Nancy, "Robot a New Face on Geriatric Care", ocregister.com, Aug. 6, 2003, 3 pages.

Mack, Michael J., "Minimally Invasive and Robotic Surgery", The Journal of the American Medical Association, vol. 285, No. 5, Feb. 7, 2001, pp. 568-572.

Mair, G. M., "Telepresence-The Technology and its Economic and Social Implications", Technology and Society, Technology and Society at a Time of Sweeping Change, Proceedings of International Symposium, Jun. 20-21, 1997, pp. 118-124.

Martin, Anya, "Brighter Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.

McCardle et al., "The Challenge of Utilizing New Technology in Design Education", Loughborough University, IDATER, 2000, pp. 122-127.

Meng et al., "E-Service Robot in Home Healthcare", Proceedings of the 2000 IEEE/RSJ, International Conference on Intelligent Robots and Systems, 2000, pp. 832-837.

Metz, Cade, "HP Labs", available online at <http://www.pcmag.com/article2/0,2817,1130820,00.asp>, Jul. 1, 2003.

Michaud, Anne, "Introducing 'Nursebot'", available online at <http://www.cs.cmu.edu/~nursebot/web/press/globe_3_01/index.html>, retrieved on May 5, 2008, Sep. 11, 2001, 4 pages.

Microsoft Corporation, Inc., "Microsoft NetMeeting 3 Features", available online at <http://technet.microsoft.com/en-us/library/cc723477.aspx>, retrieved on Jun. 26, 2012, 2012, 6 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Montemerlo, Mike, "Telepresence: Experiments in Next Generation Internet", available Online at <http://www.ri.cmu.edu/creative/archives.htm>, retrieved on May 25, 2008, Oct. 20, 1998, 3 pages.
Murphy, Robin R., "Introduction to A1 Robotics", A Bradford Book, The Massachusetts Institute of Technology Press, 2000, 487 pages.
Nakajima et al., "A Multimedia Teleteaching System using an Electronic Whiteboard for Two-Way Communication of Motion Videos and Chalkboards", Robot and Human Communication, Proceedings of 2nd IEEE International Workshop, 1993, pp. 436-441.
Nakazato et al., "Group-Based Interface for Content-Based Image Retrieval", Proceedings of the Working Conference on Advanced Visual Interfaces, 2002, pp. 187-194.
Nakazato et al., "Group-Oriented User Interface for Digital Image Management", Journal of Visual Languages and Computing, vol. 14, No. 4, Aug. 2003, pp. 45-46.
Nersc, "Berkeley Lab's RAGE Telepresence Robot Captures R&D100 Award", Available online at <https://www.nersc.gov/news-publications/news/nersc-center-news/2002/berkeley-lab-s-rage-telepresence-robot-captures-r-and-d100-award/>, Retrieved on Jan. 22, 2014, Jul. 2, 2002, 2 pages.
"Nomad XR4000 Hardware Manual", Release 1.0, Nomadic Technologies, Inc., Mar. 1999, 34 pages.
North, Michael, "Telemedicine: Sample Script and Specifications for a Demonstration of Simple Medical Diagnosis and Treatment Using Live Two-Way Video on a Computer Network", Greenstar Corporation, 1998, 5 pages.
Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2R—Experimental evaluation of the Emotional Communication between Robots and Humans", Proceedings of the 2000 IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, 2000, pp. 175-180.
Ogata et al., "Emotional Communication Robot: WAMOEBA-2R—Emotion Model and Evaluation Experiments", Proceedings of the International Conference on Humanoid Robots, 2000, pp. 1-16.
"Appeal from the U.S. District Court for the Central District of California in No. 11-CV-9185, Judge Percy Anderson", May 9, 2014, pp. 1-48.
"Google translation of: Innovations Report", From research project to television star: Care-O-bot in ZDF series, available online at <http://www.innovations-report.de/specials/printa.php?id=5157>, Sep. 28, 2001.
"MPEG File Format Summary", available at <http://www.fileformat.info/format/mpeg/egff.htm>, retrieved on Jun. 25, 2014, Feb. 1, 2001, 7 pages.
Koenen, Rob, "MPEG-4: A Powerful Standard for Use in Web and Television Environments", (KPN Research), available at <http://www.w3.org/Architecture/1998/06/Workshop/paper26>, Jul. 1, 1998, 4 pages.
CMU Course 16X62, "Robot user's manual", (describing the Nomad Scout), Carnegie Mellon University, Feb. 1, 2001, 11 pages.
Panusopone et al., "Performance comparison of MPEG-4 and H.263+ for streaming video applications", Circuits Systems Signal Processing, vol. 20, No. 3, 2001, pp. 293-309.
Schraft et al., "Care-O-botTM: The Concept of a System for Assisting Elderly or Disabled Persons in Home Environments", IEEE Proceedings of the 24th Annual Conference of the Industrial Electronics Society, IECON '98, Aug. 31-Sep. 4, 1998, pp. 2476-2481.
"Robart I, II, III", Spawar, Systems Center Pacific, Available online at <http://www.nosc.mil/robots/land/robart/robart.html>, retrieved on Nov. 22, 2010, 1998, 8 pages.
"Using your Infrared Cell Phone Camera", Available on <http://www.catsdomain.com/xray/about.htm>, retrieved on Jan. 23, 2014, Courtesy of Internet Wayback Machine, Jan. 30, 2010, 4 pages.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. I of IV, Jun. 24, 2013, pp. A1-A6357.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. II of IV, Jun. 24, 2013, pp. A6849-A10634.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. III of IV, Jun. 24, 2013, pp. A10654-A15517.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. IV of IV, Jun. 24, 2013, pp. A15677-A18127.
Reply Brief for Defendant-Appellee VGO Communications, Inc., Appeal from the U.S. District Court for the Central District of California, in Case No. 2:11-cv-9185, Judge Percy Anderson, May 28, 2013, 75 pages.
Civil Minutes-General: Case No. CV 11-9185PA (AJWx), *InTouch Tech., Inc.* v. *VGo common, Inc.*, U.S. District Court for the Central District of California, Judge Percy Anderson, Sep. 10, 2012, 7 pages.
Defendant-Counterclaimant VGo Communications, Inc.'s Supplemental Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order, U.S. District Court for the Central District of California, Case No. CV11-9185 PA, May 14, 2012, 228.
Opening Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Apr. 12, 2013, 187 pages.
Reply Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Jun. 14, 2013, 39 pages.
Active Media, Inc., "Saphira Software Manual", Real World, Saphira Version 5.3, 1997, 105 pages.
Apple Inc., "I Phone", iPhone Series, XP002696350, Sep. 21, 2012, pp. 1-29.
Blaer et al., "TopBot: Automated Network Topology Detection With a Mobile Robot", IEEE, Proceedings of the 2003 International Conference on Robotics and Automation, Taipei, Taiwan, Sep. 14-19, 2003, pp. 1582-1587.
Bradner, S., "The Internet Standards Process—Revision 3", Network Working Group, Request for Comments: 2026, BCP: 9, Obsoletes: 1602, Category: Best Current Practice, Oct. 1996, pp. 1-36.
Christensen et al., "BeeSoft User's Guide and Reference", Robots for the Real World™, Real World Interface, Inc ., Sep. 26, 1997, 203 pages.
Chu et al., "Detection of Target Mobile Signal Strength", Technical Development, Motorola Inc., Jan. 1999, pp. 205-206.
Dario et al., "A Robot Workstation for Diagnosis and Physical Therapy", IEEE Catalog No. 88TH0234-5, Centro "E. Piaggio" University of Pisa, Italy, 1989, pp. 67-72.
Gostai "Gostai Jazz: Robotic Telepresence", available online at <http://www.gostai.com>, 4 pages.
Leifer et al., "VIPRR: A Virtually in Person Rehabilitation Robot", Proceedings of 1997 International Conference on Rehabilitation Robotics, Apr. 14-15, 1997, 4 pages.
Minsky, Marvin, "Telepresence", OMNI Magazine, Jun. 1980, 6 pages.
Noritsugu et al., "Application of Rubber Artificial Muscle Manipulator as a Rehabilitation Robot", Mechatronics, IEEE/ASME Transactions, vol. 2, No. 4, Dec. 1997, pp. 259-267.
Osborn et al., "Quality of Life Technology Center", QoLT Research Overview: A National Science Foundation Engineering Research Center, Carnegie Mellon University of Pittsburgh, 2 pages.
Reynolds et al., "Review of Robotic Telemedicine Utilization in Intensive Care Units (ICUs)", 11th Annual ATA Symposium, Tampa, Florida, 2011, 1 page.
Tipsuwan et al., "Gain Adaptation of Networked Mobile Robot to Compensate QoS Deterioration", vol. 4, 28th Annual Conference of the Industrial Electronics Society, Nov. 5-8, 2002, pp. 3146-3151.
Tsui et al., "Exploring Use Cases for Telepresence Robots", 6th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Mar. 2011, 7 pages.
UMASS Lowell Robotics Lab, "Robotics Lab @ UMASS Lowell", Department of Computer Science, Brochure, 2011, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Video Middleware Cookbook, "H.350 Directory Services for Multimedia", 4 pages.
U.S. Appl. No. 10/783,760, filed Feb. 20, 2004, 48 pages.
International Search Report Received for International Patent Application No. PCT/US2005/037347, Apr. 17, 2006, 2 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US2005/037347, Apr. 17, 2006, 7 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US2006/037076, Apr. 1, 2008, 6 pages.
International Search Report and Written Opinion Received for International Application No. PCT/US2006/037076, May 11, 2007, 6 pages.
International Preliminary Report on Patentability and Written Opinion Received for International Patent Application No. PCT/US/200714099, Dec. 16, 2008, 5 pages.
International Search Report Received for International Patent Application No. PCT/US2007/14099, Jul. 30, 2008, 1 page.
Nomadic Technologies, Inc., "Nomad Scout User's Manual", Software Version 2.7, Part Number: DOC00004, Jul. 12, 1999, pp. 1-59.
ACM Digital Library Record, Autonomous Robots, vol. 11, No. 1, Table of Content, available at <http://dl.acm.org/citation.cfm?id=591550&picked=prox&cfid=360891374&cftoken=35225929>, Jul. 2001, 2 pages.
Brenner, Pablo, "A Technical Tutorial on the IEEE 802.11 Protocol", BreezeCOM Wireless Communications, Jul. 18, 1996, pp. 1-24.
Library of Congress, "008-Fixed-Length Data Elements (NR)", MARC 21 Format for Classification Data, available at <http://www.loc.gov/marc/classification/cd008.html>, retrieved on Jul. 22, 2014, pp. 1-14.
Paulos et al., "Personal Tele-Embodiment", Chapter 9 in Goldberg et al., Ed., "Beyond Webcams", MIT Press, Jan. 4, 2002, pp. 155-167.
Paulos et al., "Social Tele-Embodiment: Understanding Presence", Autonomous Robots, vol. 11, No. 1, Kluwer Academic Publishers, Jul. 2001, pp. 87-95.
Paulos, Eric John, "Personal Tele-Embodiment", Introductory and Cover Pages from 2001 Dissertation Including Contents table, together with E-mails Relating thereto from UC Berkeley Libraries, as Shelved at UC Berkeley Engineering Library (Northern Regional Library Facility), May 8, 2002, 25 pages (including 4 pages of e-mails).
Paulos, Eric John, "Personal Tele-Embodiment", OskiCat Catalog Record, UCB Library Catalog, Results page and MARC Display, retrieved on Jun. 14, 2014, 3 Pages.
Screenshot Showing Google Date for Lemaire Telehealth Manual, Screenshot Retrieved on Dec. 18, 2014, 1 page.
Nomadic Technologies, Inc., "Nomad Scout Language Reference Manual", Software Version: 2.7, Part Number: DOC00002, Jul. 12, 1999, 47 pages.
Office Action received for Chinese Patent Application No. 200680044698.0 on Nov. 4, 2010. (9 pages of Official Copy and 17 pages of English Translation).
Wang et al., "A Healthcare Tele-robotic System with a Master Remote Station with an Arbitrator", U.S. Appl. No. 60/449,762, filed Feb. 24, 2003, 28 pages.
Activmedia Robotics LLC, "Pioneer 2/PeopleBot™", Operations Manual, Version 9, Oct. 2001, 78 pages.
Adams, Chris, "Simulation of Adaptive Behavior (SAB'02)—From Animals to Animats 7", Mobile Robotics Research Group, The Seventh International Conference, available online at: <http://www.dai.ed.ac.uk/groups/mrg/MRG.html>, retrieved on Jan. 22, 2014, Aug. 4-11, 2002, 1 page.
Ando et al., "A Multimedia Self-Service Terminal with Conferencing Functions", Proceedings of 4th IEEE International Workshop on Robot and Human Communication, RO-MAN'95, Jul. 5-7, 1995, pp. 357-362.
Android Amusement Corp., "Renting Robots from Android Amusement Corp!", What Marketing Secret, (Advertisement), 1982, 1 page.
Applebome, "Planning Domesticated Robots for Tomorrow's Household", New York Times, available online at <http://www.theoldrobots.com/images17/dc17.JPG>, Mar. 4, 1982, 1 page.
Bar-Cohen et al., "Virtual Reality Robotic Telesurgery Simulations Using MEMICA Haptic System", Proceedings of SPIE's 8th Annual International Symposium on Smart Structures and Materials, Mar. 5-8, 2001, 8 pages.
Barrett, Rick, "Video Conferencing Business Soars as Companies Cut Travel; Some Travel Cuts are Permanent", available online at <http://www.ivci.com/international_videoconferencing_news_videoconferencing_news_19.html>, May 13, 2002, 2 pages.
Bartholomew, "Pharmacy Apothecary of England", BnF-Teaching Kit—Childhood in the Middle Ages, available online at <http://classes.bnf.fr/ema/grands/034.htm>, retrieved on Jul. 26, 2012, 2 pages.
Bauer et al., "Remote Telesurgical Mentoring: Feasibility and Efficacy", IEEE, Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000, pp. 1-9.
Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", BonSecours Health System, Inc., Technology Ealy Warning System, Jun. 2003, pp. 1-10.
Bischoff, Rainer, "Design Concept and Realization of the Humanoid Service Robot Hermes", in A. Zelinsky (ed.): Field and Service Robotics, Springer, London, 1998, pp. 485-492.
Blackwell, Gerry, "Video: A Wireless LAN Killer App?", Availabel online at <http://www.wi-fiplanet.com/columns/article.php/1010261/Video-A-Wireless-LAN-Killer>, retrieved on Nov. 22, 2010, Apr. 16, 2002, 4 pages.
Breslow et al., "Effect of a Multiple-Site Intensive Care Unit Telemedicine Program on Clinical and Economic Outcome an Alternative Paradigm for Intensivist Staffing", Critical Care Med., vol. 32, No. 1, Jan. 2004, pp. 31-38.
Brooks, Rodney A., "A Robust Layered Control System for a Mobile Robot", IEEE, Journal of Robotics and Automation, vol. 2, No. 1, Mar. 1986, pp. 14-23.
Brooks, Rodney Allen, "Flesh and Machines: How Robots Will Change Us", available online at <http://dl.acm.org/citation.cfm?id=560264&preflayout=flat%25202%2520of>, retrieved on Nov. 23, 2010, Feb. 2002, 3 pages.
Celi et al., "The eICU: It's Not Just Telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001, pp. 183-189.
Cheetham et al., "Interface Development for a Child's Video Conferencing Robot", Centre for Learning Technologies, Ryerson University, 2000, 4 pages.
Cleary et al., "State of the Art in Surgical Robotics: Clinical Applications and Technology Challenges", Computer Aided Surgery, Nov. 2001, pp. 1-26.
CNN, "Floating 'Droids' to Roam Space Corridors of the Future", available online at <http://edition.cnn.com/2000/TECH/space/01/12/psa/> retrieved on Nov. 11, 2010., Jan. 12, 2000, 3 pages.
cnn.com, "Paging Dr. Robot: Machine Helps Doctors with Patients", available online at <http://edition.cnn.com/2003/TECH/ptech/09/29/doctor.robot.ap/index.html>, retrieved on Sep. 30, 2003, 3 pages.
Crowley, Susan L., "Hello to Our Future", AARP Bulletin, available online at <http://www.cs.cmu.ed/-nursebot/web/press/aarp 99_14/millennium.html>, Jan. 2000, retrieved on Nov. 23, 2010, 12 pages.
Dalton, Barnaby, "Techniques for Web Telerobotics", Ph. D Thesis for degree of Doctor of Philosophy, University of Western Australia, available online at <http://telerobot.mech.uwa.edu.au/information.html>, 2001, 243 pages.
Davies, Brian, "Robotics in Minimally Invasive Surgery", Mechatronics in Medicine Lab, Dept. Mechanical Engineering, Imperial College, London SW7 2BX, The Institution of Electrical Engineers, IEE, Savoy Place, London WC2R OBL, UK, 1995, pp. 1-2.
Davis, Erik, "Telefriend, Meet iRobot, The Smartest Webcam on Wheels", Wired Magazine, Issue 8.09, available online at <htip://

(56) **References Cited**

OTHER PUBLICATIONS

www.wired.com/wired/archive/8.09/irobot.html?pg=1&topic=&topic_set=>, retrieved on Jul. 7, 2012, Sep. 2000, 3 pages.
Dean et al., "1992 AAAI Robot Exhibition and Competition", Articles, AI Magazine, vol. 14, No. 1, 1993, 15 pages.
DiGiorgio, James, "Is Your Emergency Department of the 'Leading Edge?", Chicago Hospital News, vol. 2, No. 12, Feb. 2005, 3 pages.
Dudenhoeffer et al., "Command and Control Architectures for Autonomous Micro-Robotic Forces", FY00 Project Report, Idaho National Engineering and Environmental Laboratory, Human Systems Engineering and Sciences Department, Idaho Falls, Apr. 2001, 43 pages.
Elhajj et al., "Real-Time Haptic Feedback in Internet-Based Telerobotic Operation", IEEE International Conference on Electro/Information Technology, Jun. 2000, 10 pages.
Elhajj et al., "Supermedia in Internet-Based Telerobotic Operations", Lecture Notes in Computer Science, vol. 2216, 2001, pp. 359-372.
Elhajj et al., "Synchronization and Control of Supermedia Transmission Via the Internet", Proceedings of 2001 International Symposium on Intelligent Multimedia Video and Speech Processing, Hong Kong, May 2-4, 2001, pp. 320-323.
Ellison et al., "Telerounding and Patient Satisfaction after Surgery", American College of Surgeons, Elsevier, Inc., vol. 199, No. 4, Oct. 2004, pp. 523-530.
Evans et al., "HelpMate: The Trackless Robotic Courier", PYXIS, available online at <http://www.pyxis.com/>, 3 pages.
Fels et al., "Developing a Video-Mediated Communication System for Hospitalized Children", Telemedicine Journal, vol. 5, No. 2, 1999, 30 pages.
Fetterman, David M., "Videoconferencing Over the Internet", Qualitative Health Journal, vol. 7, No. 1, May 1966. pp. 154-163.
Fiorini et al., "Health Care Robotics: A Progress Report", IEEE International Conference on Robotics and Automation, vol. 2, Apr. 20-25, 1997, pp. 1271-1276.
Fong, Terrence, "Collaborative Control: A Robot-Centric Model for Vehicle Teleoperation", The Robotics Institute Carnegie Mellon University, Nov. 2001, 197 pages.
Gaidioz et al., "Synchronizing Network Probes to Avoid Measurement Intrusiveness with the Network Weather Service", High-Performance Distributed Computing, Proceedings of the Ninth International Symposium, 2000, pp. 147-154.
Garner et al., "The Application of Telepresence in Medicine", BT Technology Journal, vol. 15, No. 4, Oct. 1, 1997, pp. 181-187.
Ghiasi et al., "A Generic Web-based Teleoperations Architecture: Details and Experience", Proceedings of SPIE, Telemanipulator and Telepresence Technologies VI, vol. 3840, No. 234, Sep. 19, 1999, 14 pages.
Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation (ICRA), vol. 2, San Francisco, California, 2000, pp. 2019-2024.
Goldberg et al., "Desktop Teleoperation via the World Wide Web", Proceedings of IEEE International Conference on Robotics and Automation, vol. 1, May 21-27, 1995, pp. 654-659.
Goldenberg et al., "Telemedicine in Otolaryngology", American Journal of Otolaryngology, vol. 23, No. 1, Jan. 2002, pp. 35-43.
Goldman, Lea, "Machine Dreams", available online at <http://www.forbes.com/globa1/2002/05271043.html>, retrieved on Nov. 23, 2010., May 27, 2002, 5 pages.
Gump, Michael D., "Robot Technology Improves VA Pharmacies", U.S. Medicine Informational Central, Jul. 2001, 3 pages.
Hameed et al., "A Review of Telemedicine", Journal of Telemedicine and Telecare, vol. 5, Supplement 1, 1999, pp. 103-106.
Han et al., "Construction of an Omnidirectional Mobile Robot Platform Based on Active Dual-Wheel Caster Mechanisms and Development of a Control Simulator", Journal of Intelligent and Robotic Systems, Kluwer Acedemic Publishers, vol. 29, Nov. 2000, pp. 257-275.
Handley et al., "SDP: Session Description Protocol", RFC 2327, available Online at <http://www.faqs.org/rfcs/rfc2327.html>, retrieved on Nov. 23, 2010, Apr. 1998, 22 pages.
Hanebeck et al., "ROMAN: A Mobile Robotic Assistant for Indoor Service Applications", Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, 1997, pp. 518-525.
NetMeeting, http://web.archive.orgjweb/2006041 723 555 5/http://transcriptions .english, Apr. 17, 2006, 2 pages.
Fulbright et al., "SWAMI: An Autonomous Mobile Robot for Inspection of Nuclear Waste of Storage Facilities", Autonomous Robots, 2, 1995, pp. 225-235.
Hameed, "A Review of Telemedicine", Journal of Telemedicine and Telecare, vol. 5, Supplement 1, 1999, 1 page.
Oh et al., "Autonomous Battery Recharging for Indoor Mobile Robots", Proceedings of Australian Conference on Robotics and Automation, 2000, pp. 1-6.
Ojha, Anand K., "An application of Virtual Reality in Rehabilitation", Proceedings of the 1994 IEEE Southeastcon Creative Technology Transfer, A Global Affair, Apr. 1994, pp. 4-6.
Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", available online at <http://www.w3.org/Conferences/WWW4/Papers/326/>, retrieved on Nov. 23, 2010, 1995, 15 pages.
Paulos et al., "Designing Personal Tele-Embodiment", Proceedings of IEEE International Conference on Robotics and Automation, vol. 4, May 16-20, 1998, pp. 3173-3178.
Paulos et al., "PRoP: Personal Roving Presence", ACM:CHI Proceedings of CHI, 1998, 8 pages.
Paulos et al., "Ubiquitous Tele-Embodiment: Applications and Implications", International Journal of Human Computer Studies, vol. 46, No. 6, Jun. 1997, pp. 861-877.
Paulos et al., "Video of PRoP 2 at Richmond Field Station", www.prop.org, Printout of Home Page of Website and Two-page Transcript of the Audio Portion of said PRoP Video, May 2001, 2 pages.
Paulos, Eric John, "Personal Tele-Embodiment", Dissertation, Doctor of Philosophy in Computer Science in the Graduate Division of the University of California at Berkeley, 2001, 282 pages.
Picturetel Corporation, "Introducing PictureTel Live200 for Windows NT", 1997, 63 pages.
Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE Transactions on Robotics and Automation, vol. 10, No. 4, Aug. 1994, pp. 480-489.
Piquepaille, Roland, "How New Technologies are Modifying Our Way of Life", Roland Piquepaille's Technology Trends, This Blog and its RSS Feed Are Moving, Oct. 31, 2004, 2 pages.
Radvision, "Making Sense of Bandwidth the NetSense Way", Network Congestion in Unmanaged Networks Bandwidth Estimation and Adaptation Techniques, Radvision's Netsense Technology, 2010, 7 pages.
Roach, Adam, "Automatic Call Back Service in SIP", Internet Engineering Task Force, Internet Draft, Category: Informational, Mar. 2000, 8 pages.
Rovetta et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and Optical Fiber Networks for Data Exchange", International Journal of Robotics Research, Vol .15, No. 3, Jun. 1, 1996, pp. 267-279.
Roy et al., "Towards Personal Service Robots for the Elderly", Workshop on Interactive Robots and Entertainment (WIRE 2000), vol. 25, Apr. 30-May 1, 2000, 7 pages.
Salemi et al., "MILO: Personal Robot Platform", IEEE/RSJ International Conference on Intelligent Robots and Systems, Aug. 2005, pp. 4089-4094.
Sandt et al., "Perceptions for a Transport Robot in Public Environments", Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, Sep. 7-11, 1997, pp. 360-365.
Sawyer, Robert J., "Inventing the Future: 2000 Years of Discovery", Available online at <http://www.sfwriter.com/pritf.htm>, retrived on May 25, 2008, Jan. 2, 2000, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Schaeffer et al., "Care-O-Bot™: The Concept of a System for Assisting Elderly or Disabled Persons in Home Environments", Proceedings of the 24th Annual Conference of the IEEE Industrial Electronics Society, vol. 4, 1998, pp. 2476-2481.
Schultz et al., "Web Interfaces for Mobile Robots in Public Places", IEEE Robotics and Automation Magazine, vol. 7, No. 1, Mar. 2000, pp. 48-56.
Shimoga et al., "Touch and Force Reflection for Telepresence Surgery", Proceedings of the 16th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Nov. 1994, pp. 1049-1050.
Siegwart et al., "Interacting Mobile Robots on the Web", Proceedings of the IEEE International Conference on Robotics and Automation, May 1999, pp. 10-15.
Simmons et al., "Xavier: An Autonomous Mobile Robot on the Web", IEEE Robotics and Automation Magazine, 1999, pp. 43-48.
Stephenson, Gary, "Dr. Robot Tested at Hopkins", Johns Hopkins Medical institutions, available online at <http://www.hopkinsmedicine.org/press/2003/august/030805.htm>, Aug. 5, 2003, 2 pages.
Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Complications of Urologic Laparoscopic Surgery: Recognition, Management and Prevention, Dec. 2002, 17 pages.
Suplee, Carl, "Mastering the Robot", available online at <http://www.cs.cmu.edu-nursebotlweb/press/wash/index.html>, retrieved on Nov. 23, 2010, Sep. 17, 2000, 5 pages.
Tahboub et al., "Dynamics Analysis and Control of a Holonomic Vehicle With Continously Variable Transmission", Journal of Dynamic Systems, Measurement and Control ASME, vol. 124, Mar. 2002, pp. 118-126.
Telepresence Research, Inc., "Telepresence Mobile Robot System", available online at <http://www.telepresence.com/telepresence-research/TELEROBOT/>, retrieved on Nov. 23, 2010, Feb. 20, 1995, 3 pages.
Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", Proceedings of the 19th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, vol. 6, Oct. 30-Nov. 2, 1997, pp. 2771-2776.
Theodosiou et al., "MuLVAT: A Video Annotation Tool Based on XML-Dictionaries and Shot Clustering", 19th International Conference, Artificial Neural Networks—ICANN, Sep. 14-17, 2009, pp. 913-922.
Thrun et al., "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", Journal of Robotics Research, vol. 19, 2000, pp. 1-35.
Time, Lists, "Office Coworker Robot", Best Inventions of 2001, Available online at <http://content.time.com/time/specials/packages/article/0,28804,1936165_1936255_1936640,00.html>, Nov. 19, 2001, 2 pages.
Tyrrell et al., "Teleconsultation in Psychology: The Use of Videolinks for Interviewing and Assessing Elderly Patients", British Geriatrics Society, Age and Ageing, vol. 30, No. 3, May 2001, pp. 191-195.
Tzafestas et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", Technical Report DEMO 2000/13, Institute of Informatics and Telecommunications, National Center for Scientific Research "Demokritos", Athens, Greece, Nov. 2000, pp. 1-23.
Urquhart, Kim, "InTouch's Robotic Companion 'Beams Up' Healthcare Experts", Medical Device Daily, the Daily Medical Technology Newspaper, vol. 7, No. 39, Feb. 27, 2003, pp. 1-4.
Weaver et al., "Monitoring and Controling Using the Internet and Java", Proceedings of the 25th Annual Conference of the IEEE Industrial Electronics Society, vol. 3, 1999, pp. 1152-1158.
Weiss et al., "Telework and Video-Mediated Communication: Importance of Real-Time, Interactive Communication for Workers with Disabilities", Available online at <http://www.telbotics.com/research_3.htm>, retrieved on Nov. 23, 2010, 1999, 3 pages.
Weiss, et al., "PEBBLES: A Personal Technology for Meeting Education, Social and Emotional Needs of Hospitalised Children", Personal and Ubiquitous Computing, vol. 5, No. 3, Aug. 2001, pp. 157-168.
West et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design, ASME, vol. 119, Jun. 1997, pp. 153-161.
Yamasaki et al., "Applying Personal Robots and Active Interface to Video Conference Systems", 6th International Conference on Human Computer Interaction, vol. B, 1995, pp. 243-248.
Yamauchi, Brian, "PackBot: A Versatile Platform for Military Robotics", Proceedings of SPIE for Military Robotics, 2004, pp. 228-237.
Yong et al., "Robot Task Execution with Telepresence Using Virtual Reality Technology", International Conference on Mechatronic Technology, Nov. 30-Dec. 2,1998, pp. 1-8.
Zambroski, James, "CMU, Pitt Developing 'Nursebot'", available online at <http://www.cs.cmu.edu/~nursebot/web/press/tribunereview.html>, retrieved on Jun. 26, 2012, Oct. 27, 2000, 3 pages.
Zamrazil, Kristie, "Telemedicine in Texas: Public Policy Concerns", Focus Report, House Research Organization, Texas House of Representatives, No. 76-22, May 5, 2000, pp. 1-16.
Zipperer, Lorri, "Robotic Dispensing System", ISMP Medication Safety Alert, vol. 4, No. 17, Aug. 25, 1999, pp. 1-2.
Zorn, Benjamin G., "Ubiquitous Telepresence", Department of Computer Science, University of Colorado, Mar. 18, 1996, 13 pages.
"Defendant VGo Communications, Inc.'s Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order", U.S. District Court for the Central District of California, in Case No. CV11-9185 PA, May 2, 2012, 143 pages.
"Magne Charge", Smart Power for Electric Vehicles, General Motors Corporation, Serial No. 75189637, Registration No. 2114006, Filing Date: Oct. 29, 1996, Aug. 26, 1997, 2 pages.
"More Online Robots: Robots that Manipulate", available online at <http://ford.ieor.berkeley.edu/ir/robots_a2.html>, retrieved on Nov. 23, 2010, Aug. 2001, 2 pages.
"PictureTel Adds New Features and Functionality to its Award-Winning Live200 Desktop Videoconferencing System", PR Newswire Association, LLC, Gale, Cengage Learning, Jun. 13, 1997, 4 pages.

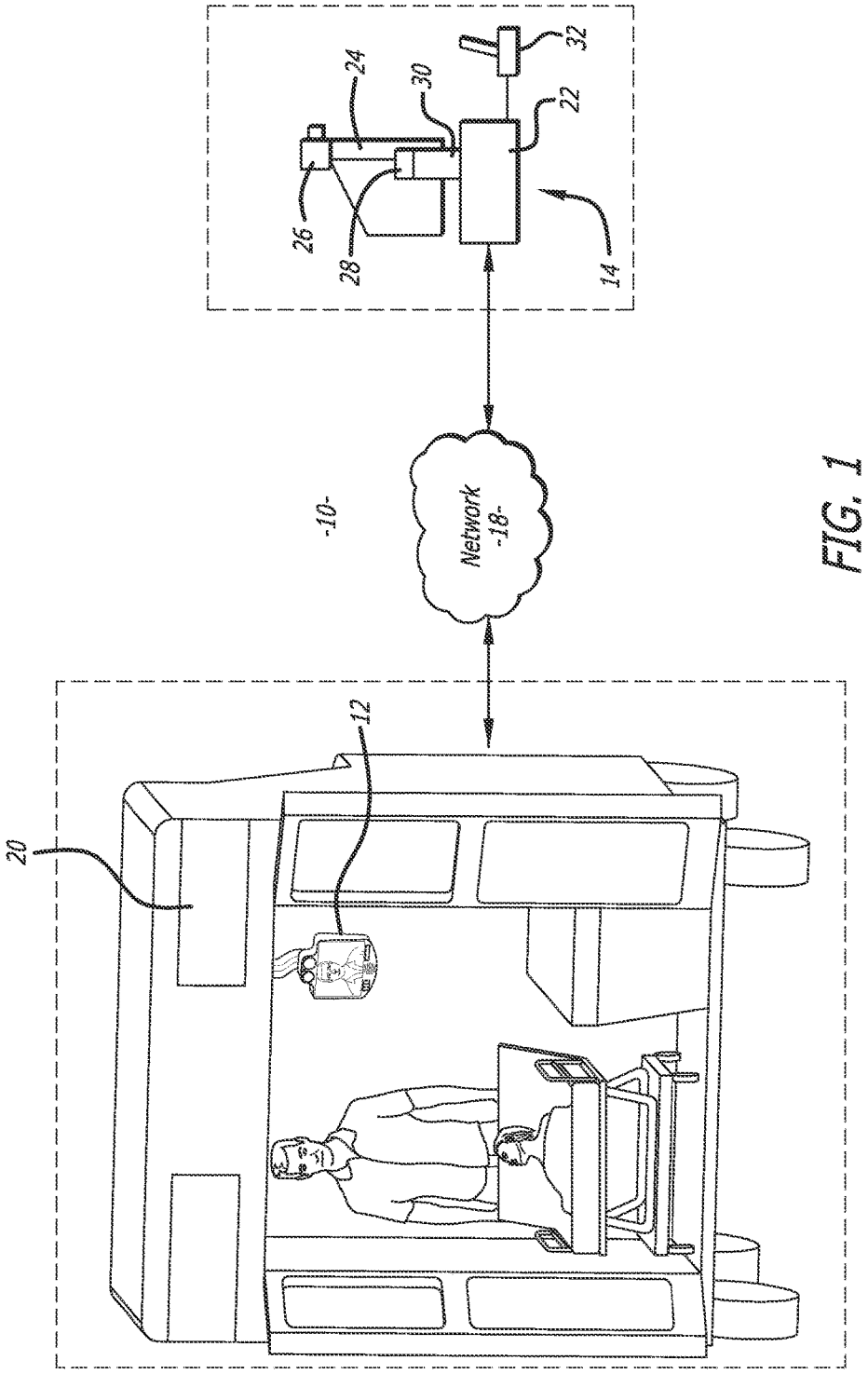


FIG. 1

FIG. 2

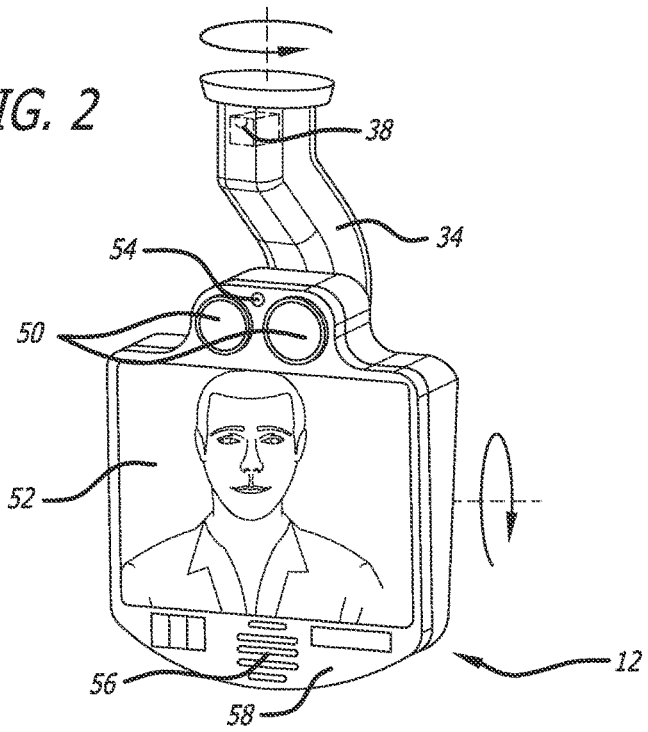
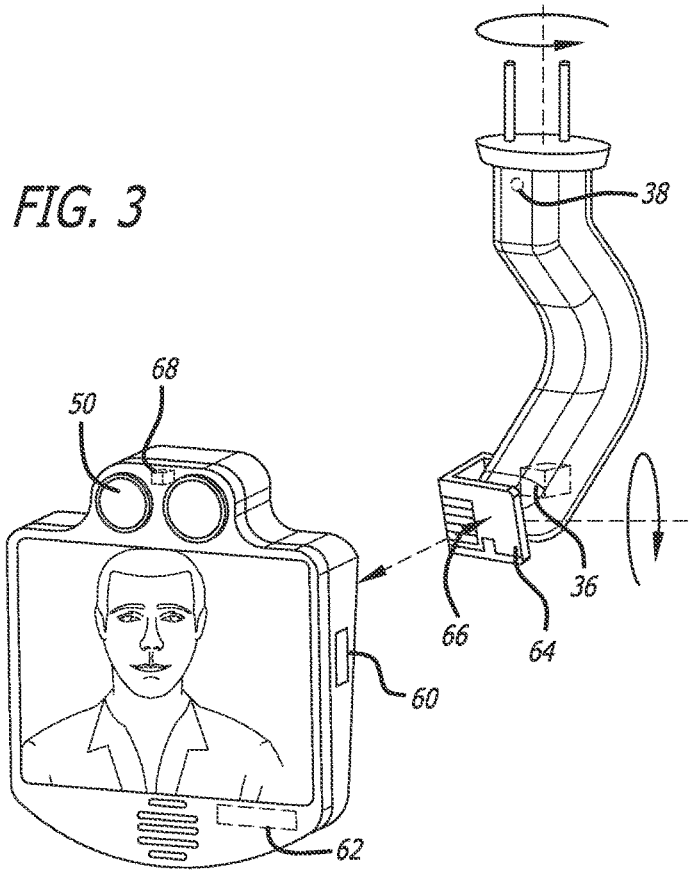


FIG. 3



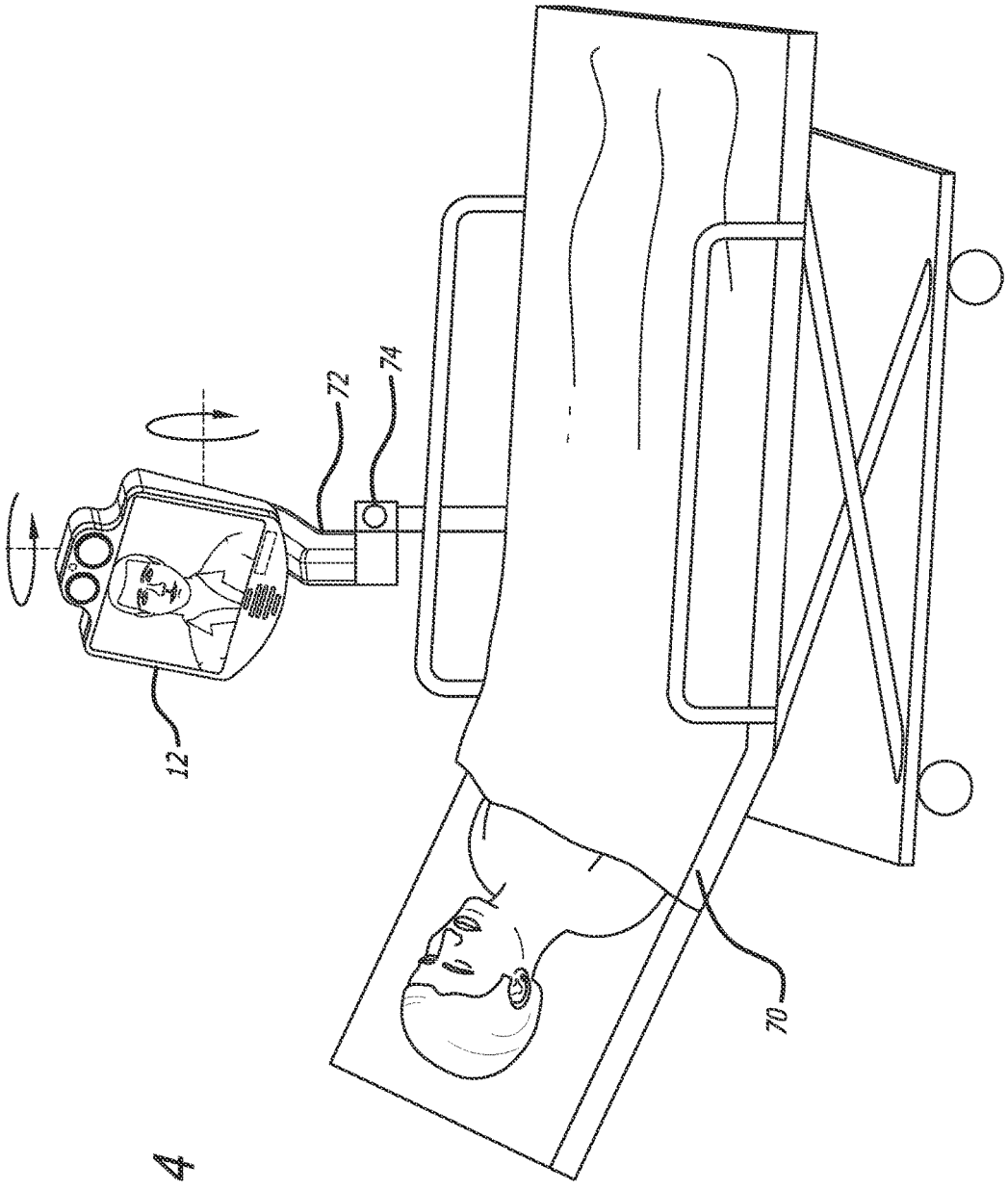


FIG. 4

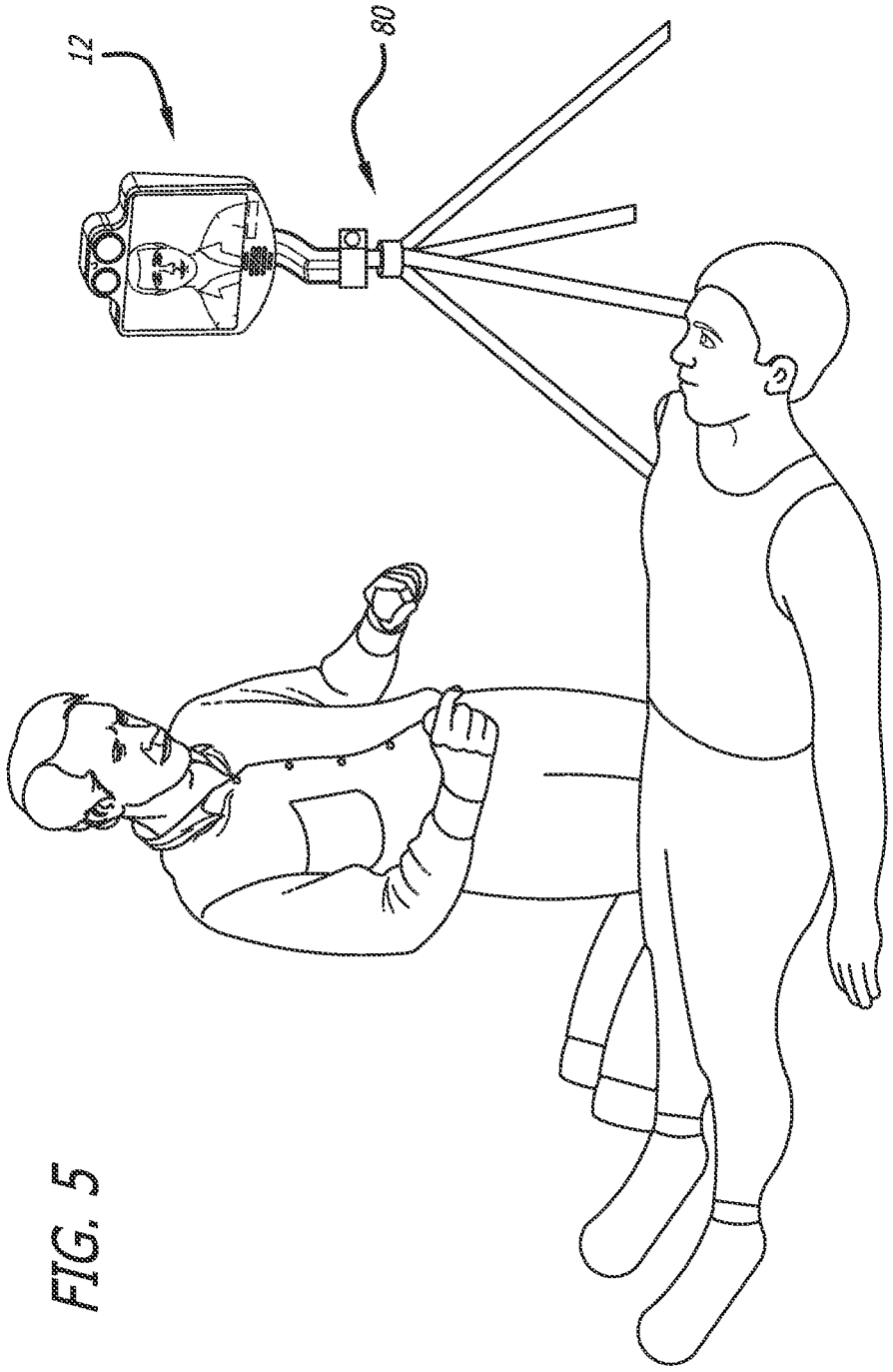
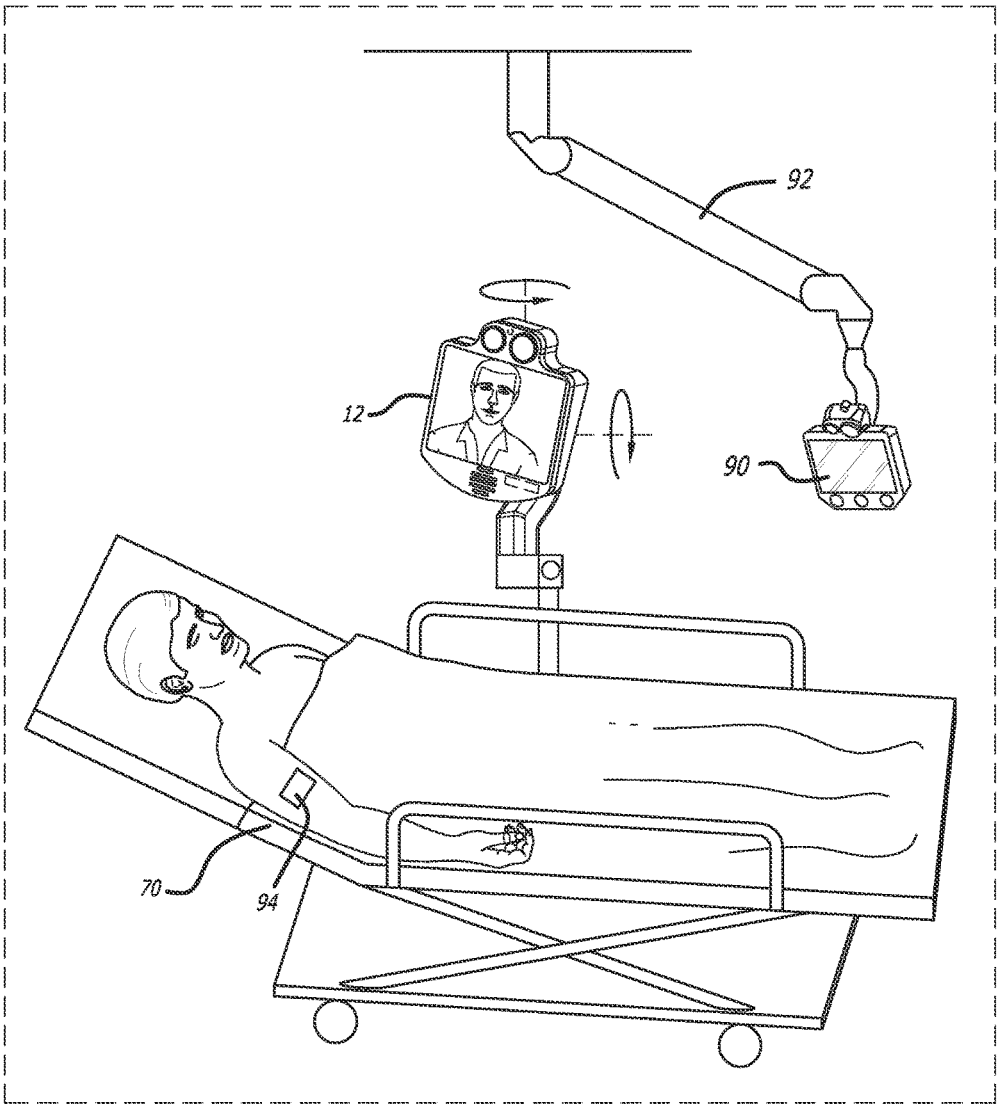


FIG. 5

FIG. 6



PORTABLE REMOTE PRESENCE ROBOT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the field of robotic tele-presence systems.

2. Background Information

Robots have been used in a variety of applications. For example, robots have been used in manufacturing facilities, bomb detection/detonation, medical facilities, etc. The assignee of the present application has developed a tele-presence robot that includes a robot that is remotely controlled through a remote control station. The system is marketed under the product name RP-7. Both the robot and the remote station include cameras, monitors, microphones and speakers to allow for two audio-visual communication. The remote station also includes a joystick that can be operated by the user to move the robot and a robot head.

BRIEF SUMMARY OF THE INVENTION

A tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a tele-presence system that includes a remote station coupled to a portable robot face located within an ambulance;

FIG. **2** is an illustration showing the portable robot face within the ambulance;

FIG. **3** is an illustration showing the portable robot face detached from a platform mounted to the ambulance ceiling;

FIG. **4** is an illustration showing the portable robot face attached to a patient gurney;

FIG. **5** is an illustration showing the portable robot face attached to a stand;

FIG. **6** is an illustration showing a patient within a healthcare facility that has a robot face attached to a boom.

DETAILED DESCRIPTION

Disclosed is a tele-presence system that includes a portable robot face coupled to a remote station. The robot face includes a robot monitor, a robot camera, a robot speaker and a robot microphone. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The portable robot face can be attached to a platform mounted to the ceiling of an ambulance. The portable robot face can be used by a physician at the remote station to provide remote medical consultation. When the patient is moved from the ambulance the portable robot face can be detached from the platform and moved with the patient.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows a tele-presence system **10**. The system **10** includes a portable robot face **12** that is coupled to a remote control station **14** through a wireless network **18**. The wireless network may be a cellular broadband network and/or a WiFi network. The portable robot face **12** is located within an ambulance **20**.

The remote control station **14** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **14** is typically located in a place that is remote from the robot face **12**. Although only one remote control station **14** is shown, the system **10** may include a plurality of remote stations **14**. In general any number of robot faces **12** may be coupled to any number of remote stations **14** or other robot faces **12**. For example, one remote station **14** may be coupled to a plurality of robot faces **12**, or one robot face **12** may be coupled to a plurality of remote stations **14**, or a plurality of robot faces **12**. The system may include an arbitrator (not shown) that controls access between the robot face(s) **12** and the remote stations **14**.

As shown in FIGS. **2** and **3**, the portable robot face **12** may be attached to a platform **34**. The platform **34** may extend from the ceiling (not shown) of the ambulance **20**. The platform **34** may include articulate joints **36** and **38** that provide at least two degrees of freedom and allow a user to move the robot face **12** to different positions to view a patient and an EMT within the ambulance.

Each robot face **12** includes a camera(s) **50**, a monitor **52**, a microphone(s) **54** and a speaker(s) **56** that are all attached to a housing **58**. The robot camera **50** is coupled to the remote monitor **24** so that a user at the remote station **14** can view the patient and/or EMT. Likewise, the robot monitor **52** is coupled to the remote camera **26** so the patient and EMT may view the user of the remote station **14**. The microphones **28** and **54**, and speakers **30** and **56**, allow for audible communication between the system operator and the patient and/or EMT.

The system **10** allows a system user such as a physician to view a patient in the ambulance and provide remote medical consultation through the remote station **14** and the robot face **12**. Personnel such as the EMT can transmit questions and responses through the system back to the physician. The robot camera **50** allows the physician to view the patient and enhance the medical consultation. The robot monitor **52** can display the physician to provide a feeling of presence in the ambulance. The platform **34** allows the physician to pan and tilt the robot face **12**.

The robot face **12** may include a wireless transceiver **60** that is coupled to the wireless network. The portable face **12** also includes a battery **62**.

The system **10** may have certain components and software that are the same or similar to a robotic system provided by the assignee InTouch-Health, Inc. of Santa Barbara, Calif. under the name RP-7 and embodies a system described in U.S. Pat. No. 6,925,357, which is hereby incorporated by reference.

As shown in FIG. **3**, the portable robot face **12** can be detached from the platform **34**. The robot face **12** and platform **34** may have mechanical connectors **64** that allow the face **12** to be readily attached and detached from the platform **34**. Likewise, the robot face **12** and platform **34** may include electrical connectors **66**. The ambulance may include a wireless transceiver (not shown) that can provide wireless communication to the remote station. The electrical connectors **66** provide an electrical connection between the robot face **12** and the ambulance wireless transceiver. The connectors **66** may also provide power to the robot face **12**. Alternatively, the wireless transceiver **60** of the robot face **12** may be coupled to the remote station through the ambulance wireless transceiver. The robot face may include an actuator system **68** that can move the camera **50** in two degrees of freedom. This allows the operator to move the camera field of view even when the face **12** is detached from the platform **34**.

As shown in FIG. **4** the portable robot face **12** can be detached from the platform (not shown) and attached to the patient gurney **70**. The robot face **12** may be attached to a platform **72** with two degrees of freedom that allow the remote station user to move the robot face **12**. The platform **72** may include a clamp **74** that allows for attachment to the gurney **70**. The robot face **12** and patient can be moved out of the ambulance on the gurney **70**. The portable aspect of the robot face **12** allows the face to be moved with the patient. The robot face **12** should be of a size and weight so that an individual can lift the face **12**.

As shown in FIG. **5** the portable robot face **12** can be detached from the ambulance platform (not shown) and attached to a stand **80** at a remote location. The portable nature of the robot face **12** allows the face **12** to be taken to any location to allow for remote tele-presence of the operator of the remote station. If the operator is a physician the portable robot face **12** allows for remote medical consultation at any site.

FIG. **6** shows the patient and gurney moved into a healthcare facility with a robot face **90** attached to a boom **92**. When the gurney **70** is moved into close proximity with the healthcare facility the robot face wireless transceiver may be coupled to the remote station thru the healthcare facility local wireless network such as a WiFi network. Once inside the facility the portable robot face can be connected to an electrical power outlet and a network for Ethernet connection. An electronic ID device **94** may be attached to the patient. The ID device **94** may transmit a wireless signal to the robot face **90** attached to the boom **92**. Receipt of the signal by the face **90** may cause the remote station to be coupled to the robot face **90** attached to the boom **92** instead of the portable robot face **12**. The robot face **90** may be coupled to the remote station by other means. For example, a nurse may type in information into the healthcare facility network system that identifies the new location of the patient. Such an entry may cause the system to switch the remote control station to the robot face **90**. Additionally, there may be other methodologies for inducing the system to automatically transfer the remote station from one robot to another robot.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A portable robot face that is adapted to be coupled to a remote station that has a station monitor, a station camera, a station speaker and a station microphone, comprising:

a housing;

a camera coupled to said housing;

a monitor that is coupled to said housing and is adapted to display images captured by the station camera;

a speaker that is coupled to said housing and is adapted to generate a sound provided through the station microphone;

a microphone coupled to said housing;

a battery coupled to said housing;

a wireless transceiver coupled to said housing; and,

a clamp adapted to attach and detach said housing to and from a platform, wherein said robot face is operable when said housing is detached from said platform.

2. The portable robot face of claim **1**, wherein the root face is attached to the platform with two degrees of freedom relative to the platform.

3. The portable robot face of claim **2**, further comprising an electrical connector adapted to be attached to said platform.

4. The portable robot face of claim **1**, wherein the battery is disposed within the housing.

* * * * *

Exhibit G

US008670017B2

(12) **United States Patent**
Stuart et al.

(10) **Patent No.: US 8,670,017 B2**
(45) **Date of Patent: Mar. 11, 2014**

(54) **REMOTE PRESENCE SYSTEM INCLUDING A CART THAT SUPPORTS A ROBOT FACE AND AN OVERHEAD CAMERA**

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G06F 17/00	(2006.01)
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(52) **U.S. Cl.**

USPC **348/14.05**; 5/424; 219/137.2; 312/215; 348/14.08; 348/14.09; 375/240.12; 600/300; 600/301; 700/248; 700/253; 700/259; 702/150; 705/2; 706/11

(58) **Field of Classification Search**

USPC 5/424; 219/137.2; 312/215; 348/14.05, 348/14.09, 14.08; 375/240.12; 600/300, 600/301; 700/259, 248, 253; 702/150; 706/11; 705/2

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995 A 7/1974 Aghnides
4,413,693 A 11/1983 Derby

(Continued)

FOREIGN PATENT DOCUMENTS

CA 2 289 697 A1 11/1998
CN 1554193 A 12/2004

(Continued)

OTHER PUBLICATIONS

Barrett, "Video Conferencing Business Soars as Companies Cut Travel; Some Travel Cuts Are Permanent", http://www.ivci.com/international_videoconferencing_news_videoconferencing_news_19.html, Mar. 13, 2002.

(Continued)

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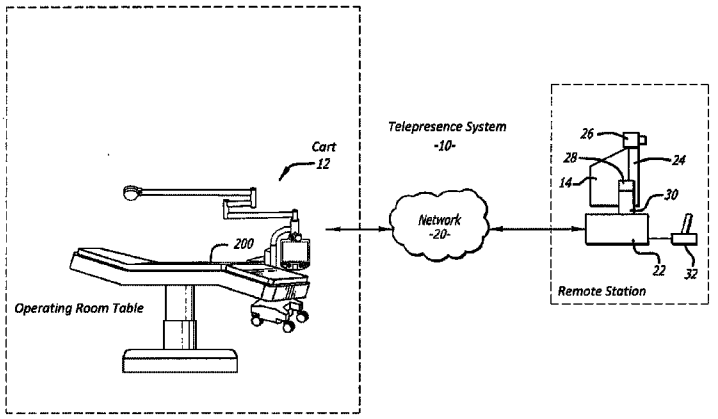
(57) **ABSTRACT**

A tele-presence system that includes a cart. The cart includes a robot face that has a robot monitor, a robot camera, a robot speaker, a robot microphone, and an overhead camera. The system also includes a remote station that is coupled to the robot face and the overhead camera. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The remote station can display video images captured by the robot camera and/or overhead camera. By way of example, the cart can be used in an operating room, wherein the overhead camera can be placed in a sterile field and the robot face can be used in a non-sterile field. The user at the remote station can conduct a teleconference through the robot face and also obtain a view of a medical procedure through the overhead camera.

30 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,471,354	A	9/1984	Smith
4,519,466	A	5/1985	Shiraishi
4,572,594	A	2/1986	Schwartz
4,625,274	A	11/1986	Schroeder
4,638,445	A	1/1987	Mattaboni
4,652,204	A	3/1987	Arnett
4,669,168	A	6/1987	Tamura et al.
4,697,472	A	10/1987	Hiyane
4,709,265	A	11/1987	Silverman et al.
4,733,737	A	3/1988	Falamak
4,751,658	A	6/1988	Kadonoff et al.
4,766,581	A	8/1988	Korn et al.
4,777,416	A	10/1988	George, II et al.
4,797,557	A	1/1989	Ohman
4,803,625	A	2/1989	Fu et al.
4,847,764	A	7/1989	Halvorson
4,875,172	A	10/1989	Kanayama
4,942,512	A	7/1990	Kohno
4,942,538	A	7/1990	Yuan et al.
4,953,159	A	8/1990	Hayden et al.
4,974,607	A	12/1990	Miwa
4,977,971	A	12/1990	Crane, III et al.
5,006,988	A	4/1991	Borenstein et al.
5,040,116	A	8/1991	Evans et al.
5,051,906	A	9/1991	Evans et al.
5,073,749	A	12/1991	Kanayama
5,084,828	A	1/1992	Kaufman et al.
5,130,794	A	7/1992	Ritchey
5,148,591	A	9/1992	Pryor
5,153,833	A	10/1992	Gordon et al.
5,155,684	A	10/1992	Burke et al.
5,157,491	A	10/1992	Kassatly
5,182,641	A	1/1993	Diner et al.
5,186,270	A	2/1993	West
5,193,143	A	3/1993	Kaemmerer et al.
5,217,453	A	6/1993	Wilk
5,224,157	A	6/1993	Yamada et al.
5,231,693	A	7/1993	Backes et al.
5,236,432	A	8/1993	Matsen, II et al.
5,315,287	A	5/1994	Sol
5,319,611	A	6/1994	Korba
5,341,242	A	8/1994	Gilboa et al.
5,341,459	A	8/1994	Backes
5,341,854	A	8/1994	Zezulka et al.
5,350,033	A	9/1994	Kraft
5,366,896	A	11/1994	Margrey et al.
5,374,879	A	12/1994	Pin et al.
5,417,210	A	5/1995	Funda et al.
5,419,008	A	5/1995	West
5,436,542	A	7/1995	Petelin et al.
5,441,042	A	8/1995	Putman
5,441,047	A	8/1995	David et al.
5,442,728	A	8/1995	Kaufman et al.
5,462,051	A	10/1995	Oka et al.
5,528,289	A	6/1996	Cortjens et al.
5,539,741	A	7/1996	Barraclough et al.
5,544,649	A	8/1996	David et al.
5,550,577	A	8/1996	Verbiest et al.
5,553,609	A	9/1996	Chen et al.
5,572,229	A	11/1996	Fisher
5,572,999	A	11/1996	Funda et al.
5,594,859	A	1/1997	Palmer et al.
5,600,573	A	2/1997	Hendricks et al.
5,630,566	A	5/1997	Case
5,636,218	A	6/1997	Ishikawa
5,652,849	A	7/1997	Conway et al.
5,657,246	A	8/1997	Hogan et al.
5,659,779	A	8/1997	Laird et al.
5,682,199	A	10/1997	Lankford
5,684,695	A	11/1997	Bauer
5,701,904	A	12/1997	Simmons et al.
5,739,657	A	4/1998	Takayama et al.
5,749,058	A	5/1998	Hashimoto
5,749,362	A	5/1998	Funda et al.
5,762,458	A	6/1998	Wang et al.
5,764,731	A	6/1998	Yablon
5,767,897	A	6/1998	Howell
5,786,846	A	7/1998	Hiroaki
5,802,494	A	9/1998	Kuno
5,836,872	A	11/1998	Kenet et al.
5,838,575	A	11/1998	Lion
5,857,534	A	1/1999	DeVault et al.
5,867,653	A	2/1999	Aras et al.
5,876,325	A	3/1999	Mizuno et al.
5,911,036	A	6/1999	Wright et al.
5,917,958	A	6/1999	Nunally et al.
5,927,423	A	7/1999	Wada et al.
5,949,758	A	9/1999	Kober
5,954,692	A	9/1999	Smith et al.
5,959,423	A	9/1999	Nakanishi et al.
5,966,130	A	10/1999	Benman, Jr.
5,973,724	A	10/1999	Riddle
5,974,446	A	10/1999	Sonnenreich et al.
5,995,884	A	11/1999	Allen et al.
5,999,977	A	12/1999	Riddle
6,006,946	A	12/1999	Williams et al.
6,036,812	A	3/2000	Williams et al.
6,133,944	A	10/2000	Braun et al.
6,135,228	A	10/2000	Asada et al.
6,148,100	A	11/2000	Anderson et al.
6,170,929	B1	1/2001	Wilson et al.
6,175,779	B1	1/2001	Barrett
6,201,984	B1	3/2001	Funda et al.
6,211,903	B1	4/2001	Bullister
6,219,587	B1	4/2001	Ahlin et al.
6,232,735	B1	5/2001	Baba et al.
6,233,504	B1	5/2001	Das et al.
6,256,556	B1	7/2001	Zenke
6,259,806	B1	7/2001	Green
6,259,956	B1	7/2001	Myers et al.
6,266,162	B1	7/2001	Okamura et al.
6,266,577	B1	7/2001	Popp et al.
6,289,263	B1	9/2001	Mukherjee
6,292,713	B1	9/2001	Jouppi et al.
6,304,050	B1	10/2001	Skaar et al.
6,321,137	B1	11/2001	De Smet
6,325,756	B1	12/2001	Webb et al.
6,327,516	B1	12/2001	Zenke
6,330,486	B1	12/2001	Padula
6,330,493	B1	12/2001	Takahashi et al.
6,346,950	B1	2/2002	Jouppi
6,346,962	B1	2/2002	Goodridge
6,369,847	B1	4/2002	James et al.
6,381,515	B1	4/2002	Inoue et al.
6,408,230	B2	6/2002	Wada
6,430,471	B1	8/2002	Kintou et al.
6,430,475	B2	8/2002	Okamoto et al.
6,438,457	B1	8/2002	Yokoo et al.
6,452,915	B1	9/2002	Jorgensen
6,457,043	B1	9/2002	Kwak et al.
6,459,955	B1	10/2002	Bartsch et al.
6,463,352	B1	10/2002	Tadokoro et al.
6,463,361	B1	10/2002	Wang et al.
6,466,844	B1	10/2002	Wang et al.
6,468,265	B1	10/2002	Evans et al.
6,474,434	B1	11/2002	Bech
6,480,762	B1	11/2002	Uchikubo et al.
6,491,701	B2	12/2002	Tierney et al.
6,496,099	B2	12/2002	Wang et al.
6,496,755	B2	12/2002	Wallach et al.
6,501,740	B1	12/2002	Sun et al.
6,507,773	B2	1/2003	Parker et al.
6,522,906	B1	2/2003	Salisbury et al.
6,523,629	B1	2/2003	Buttz et al.
6,526,332	B2	2/2003	Sakamoto et al.
6,529,765	B1	3/2003	Franck et al.
6,529,802	B1	3/2003	Kawakita et al.
6,532,404	B2	3/2003	Colens
6,535,182	B2	3/2003	Stanton
6,535,793	B2	3/2003	Allard
6,540,039	B1	4/2003	Yu et al.
6,543,899	B2	4/2003	Covannon et al.
6,549,215	B2	4/2003	Jouppi
6,563,533	B1	5/2003	Colby

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,580,246 B2 6/2003 Jacobs
6,584,376 B1 6/2003 Van Kommer
6,587,750 B2 7/2003 Gerbi et al.
6,594,269 B1 7/2003 Polcyn
6,594,552 B1 7/2003 Nowlin et al.
6,602,469 B1 8/2003 Maus et al.
6,604,019 B2 8/2003 Ahlin et al.
6,604,021 B2 8/2003 Imai et al.
6,611,120 B2 8/2003 Song et al.
6,646,677 B2 11/2003 Noro et al.
6,650,748 B1 11/2003 Edwards et al.
6,684,129 B2 1/2004 Salisbury et al.
6,691,000 B2 2/2004 Nagai et al.
6,710,797 B1 3/2004 McNelley et al.
6,728,599 B2 4/2004 Wang et al.
6,763,282 B2 7/2004 Glenn et al.
6,764,373 B1 7/2004 Osawa et al.
6,769,771 B2 8/2004 Trumbull
6,781,606 B2 8/2004 Jouppi
6,784,916 B2 8/2004 Smith
6,785,589 B2 8/2004 Eggenberger et al.
6,791,550 B2 9/2004 Goldhor et al.
6,798,753 B1 9/2004 Doganata et al.
6,799,065 B1 9/2004 Niemeyer
6,799,088 B2 9/2004 Wang et al.
6,804,580 B1 10/2004 Stoddard et al.
6,804,656 B1 10/2004 Rosenfeld et al.
6,810,411 B1 10/2004 Coughlin et al.
6,836,703 B2 12/2004 Wang et al.
6,839,612 B2 1/2005 Sanchez et al.
6,840,904 B2 1/2005 Goldberg
6,845,297 B2 1/2005 Allard
6,852,107 B2 2/2005 Wang et al.
6,853,878 B2 2/2005 Hirayama et al.
6,853,880 B2 2/2005 Sakagami et al.
6,871,117 B2 3/2005 Wang et al.
6,879,879 B2 4/2005 Jouppi et al.
6,888,333 B2 5/2005 Laby
6,892,112 B2 5/2005 Wang et al.
6,895,305 B2 5/2005 Lathan et al.
6,898,484 B2 5/2005 Lemelson et al.
6,914,622 B1 7/2005 Smith et al.
6,925,357 B2 8/2005 Wang et al.
6,951,535 B2 10/2005 Ghodoussi et al.
6,952,470 B1 10/2005 Tioe
6,958,706 B2 10/2005 Chaco et al.
6,965,394 B2 11/2005 Gutta et al.
6,995,664 B1 2/2006 Darling
7,030,757 B2 4/2006 Matsuhira et al.
7,058,689 B2 6/2006 Parker et al.
7,092,001 B2 8/2006 Schulz
7,096,090 B1 8/2006 Zweig
7,115,102 B2 10/2006 Abbruscato
7,117,067 B2 10/2006 McLurkin et al.
7,123,285 B2 10/2006 Smith et al.
7,123,974 B1 10/2006 Hamilton
7,123,991 B2 10/2006 Graf et al.
7,129,970 B2 10/2006 James et al.
7,133,062 B2 11/2006 Castles
7,142,945 B2 11/2006 Wang et al.
7,142,947 B2 11/2006 Wang et al.
7,151,982 B2 12/2006 Liff et al.
7,154,526 B2 12/2006 Foote et al.
7,155,306 B2 12/2006 Haitin et al.
7,156,809 B2 1/2007 Quy
7,158,859 B2 1/2007 Wang et al.
7,158,860 B2 1/2007 Wang et al.
7,161,322 B2 1/2007 Wang et al.
7,162,338 B2 1/2007 Goncalves et al.
7,164,969 B2 1/2007 Wang et al.
7,171,286 B2 1/2007 Wang et al.
7,174,238 B1 2/2007 Zweig
7,184,559 B2 2/2007 Jouppi
7,188,000 B2 3/2007 Chiappetta et al.
7,199,790 B2 4/2007 Rosenberg et al.
7,202,851 B2 4/2007 Cunningham et al.
7,206,627 B2 4/2007 Abovitz et al.
7,215,786 B2 5/2007 Nakadai
7,227,334 B2 6/2007 Yang et al.
7,256,708 B2 8/2007 Rosenfeld
7,262,573 B2 8/2007 Wang et al.
7,289,883 B2 10/2007 Wang et al.
7,292,912 B2 11/2007 Wang et al.
7,321,807 B2 1/2008 Laski
7,346,429 B2 3/2008 Goldenberg et al.
7,382,399 B1 6/2008 McCall
7,386,730 B2 6/2008 Uchikubo
7,432,949 B2 10/2008 Remy et al.
7,441,953 B2 10/2008 Banks
7,525,281 B2 4/2009 Koyanagi et al.
7,535,486 B2 5/2009 Motomura et al.
7,593,030 B2 9/2009 Wang et al.
7,624,166 B2 11/2009 Foote et al.
7,719,229 B2 5/2010 Kaneko et al.
7,761,185 B2 7/2010 Wang et al.
7,769,492 B2 8/2010 Wang et al.
7,813,836 B2 10/2010 Wang et al.
7,831,575 B2 11/2010 Trossell et al.
7,835,775 B2 11/2010 Sawayama et al.
RE42,288 E 4/2011 Degioanni
7,924,323 B2 4/2011 Walker et al.
7,949,616 B2 * 5/2011 Levy et al. 706/11
7,982,763 B2 7/2011 King
7,987,069 B2 * 7/2011 Rodgers et al. 702/150
8,077,963 B2 12/2011 Wang et al.
8,116,910 B2 * 2/2012 Walters et al. 700/259
8,170,241 B2 5/2012 Roe et al.
8,179,418 B2 * 5/2012 Wright et al. 348/14.05
8,209,051 B2 6/2012 Wang et al.
8,292,807 B2 * 10/2012 Perkins et al. 600/301
8,340,819 B2 * 12/2012 Mangaser et al. 700/253
8,463,435 B2 * 6/2013 Herzog et al. 700/248
2001/0002448 A1 5/2001 Wilson et al.
2001/0010053 A1 7/2001 Ben-Shachar et al.
2001/0034475 A1 10/2001 Flach et al.
2001/0034544 A1 10/2001 Mo
2001/0037163 A1 11/2001 Allard
2001/0048464 A1 * 12/2001 Barnett 348/14.08
2001/0051881 A1 12/2001 Filler
2001/0054071 A1 12/2001 Loeb
2001/0055373 A1 12/2001 Yamashita
2002/0015296 A1 2/2002 Howell
2002/0027597 A1 3/2002 Sachau
2002/0049517 A1 4/2002 Ruffner
2002/0055917 A1 5/2002 Muraca
2002/0057279 A1 5/2002 Jouppi
2002/0058929 A1 5/2002 Green
2002/0059587 A1 5/2002 Cofano et al.
2002/0063726 A1 5/2002 Jouppi
2002/0073429 A1 6/2002 Beane et al.
2002/0082498 A1 6/2002 Wendt et al.
2002/0095238 A1 7/2002 Ahlin et al.
2002/0098879 A1 7/2002 Rheey
2002/0104094 A1 8/2002 Alexander et al.
2002/0111988 A1 8/2002 Sato
2002/0120362 A1 8/2002 Lathan et al.
2002/0130950 A1 9/2002 James et al.
2002/0141595 A1 10/2002 Jouppi
2002/0143923 A1 10/2002 Alexander
2002/0177925 A1 11/2002 Onishi et al.
2002/0183894 A1 12/2002 Wang et al.
2002/0184674 A1 12/2002 Xi et al.
2002/0186243 A1 12/2002 Ellis et al.
2003/0030397 A1 2/2003 Simmons
2003/0048481 A1 3/2003 Kobayashi
2003/0050733 A1 3/2003 Wang et al.
2003/0060808 A1 3/2003 Wilk
2003/0063600 A1 4/2003 Noma et al.
2003/0069752 A1 4/2003 Ledain et al.
2003/0100892 A1 5/2003 Morley et al.
2003/0104806 A1 6/2003 Ruef et al.
2003/0114962 A1 6/2003 Niemeyer
2003/0126361 A1 7/2003 Slater et al.
2003/0135203 A1 7/2003 Wang et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0144579 A1 7/2003 Buss
2003/0144649 A1 7/2003 Ghodoussi et al.
2003/0151658 A1 8/2003 Smith
2003/0152145 A1* 8/2003 Kawakita 375/240.12
2003/0171710 A1 9/2003 Bassuk et al.
2003/0174285 A1 9/2003 Trumbull
2003/0180697 A1 9/2003 Kim et al.
2003/0199000 A1 10/2003 Valkirs et al.
2003/0206242 A1 11/2003 Choi et al.
2003/0216834 A1 11/2003 Allard
2003/0220541 A1 11/2003 Salisbury et al.
2003/0220715 A1 11/2003 William et al.
2003/0231244 A1 12/2003 Bonilla et al.
2003/0232649 A1 12/2003 Gizis et al.
2004/0010344 A1 1/2004 Hiratsuka
2004/0012362 A1 1/2004 Tsurumi
2004/0013295 A1 1/2004 Sabe et al.
2004/0019406 A1 1/2004 Wang et al.
2004/0024490 A1 2/2004 McLurkin et al.
2004/0041904 A1 3/2004 Lapalme et al.
2004/0065073 A1 4/2004 Nash
2004/0068657 A1 4/2004 Alexander et al.
2004/0078219 A1 4/2004 Kaylor et al.
2004/0080610 A1* 4/2004 James et al. 348/14.09
2004/0088077 A1 5/2004 Jouppi et al.
2004/0093409 A1 5/2004 Thompson et al.
2004/0098167 A1 5/2004 Yi et al.
2004/0102167 A1 5/2004 Shim et al.
2004/0117065 A1 6/2004 Wang et al.
2004/0138547 A1 7/2004 Wang et al.
2004/0143421 A1 7/2004 Wang et al.
2004/0148638 A1 7/2004 Weisman et al.
2004/0153211 A1 8/2004 Kamoto et al.
2004/0157612 A1 8/2004 Kim
2004/0162637 A1 8/2004 Wang et al.
2004/0167666 A1 8/2004 Wang et al.
2004/0167668 A1 8/2004 Wang et al.
2004/0170300 A1 9/2004 Jouppi
2004/0172301 A1 9/2004 Mihai et al.
2004/0174129 A1 9/2004 Wang et al.
2004/0175684 A1 9/2004 Kaasa et al.
2004/0179714 A1 9/2004 Jouppi et al.
2004/0189700 A1 9/2004 Mandavilli et al.
2004/0201602 A1 10/2004 Mody et al.
2004/0215490 A1 10/2004 Duchon et al.
2004/0224676 A1 11/2004 Iseki
2004/0230340 A1 11/2004 Fukuchi et al.
2004/0240981 A1 12/2004 Dothan
2005/0003330 A1 1/2005 Asgarinejad
2005/0007445 A1 1/2005 Foote et al.
2005/0013149 A1 1/2005 Trossell
2005/0021182 A1 1/2005 Wang et al.
2005/0021183 A1 1/2005 Wang et al.
2005/0021187 A1 1/2005 Wang et al.
2005/0021309 A1 1/2005 Alexander et al.
2005/0024485 A1 2/2005 Castles et al.
2005/0027567 A1 2/2005 Taha
2005/0027794 A1 2/2005 Decker
2005/0028221 A1 2/2005 Liu et al.
2005/0035862 A1 2/2005 Wildman et al.
2005/0038416 A1 2/2005 Wang et al.
2005/0038564 A1 2/2005 Burick et al.
2005/0049898 A1 3/2005 Hirakawa
2005/0052527 A1 3/2005 Remy et al.
2005/0065438 A1 3/2005 Miller
2005/0065659 A1 3/2005 Tanaka et al.
2005/0065813 A1 3/2005 Mishelevich et al.
2005/0071046 A1 3/2005 Miyazaki et al.
2005/0083011 A1 4/2005 Yang et al.
2005/0104964 A1 5/2005 Bovyrin et al.
2005/0110867 A1 5/2005 Schulz
2005/0122390 A1 6/2005 Wang et al.
2005/0154265 A1 7/2005 Miro et al.
2005/0182322 A1 8/2005 Grispo
2005/0192721 A1 9/2005 Jouppi
2005/0204438 A1 9/2005 Wang et al.
2005/0212478 A1 9/2005 Takenaka
2005/0219356 A1 10/2005 Smith et al.
2005/0225634 A1 10/2005 Brunetti et al.
2005/0231156 A1 10/2005 Yan
2005/0232647 A1 10/2005 Takenaka
2005/0267826 A1 12/2005 Levy et al.
2005/0283414 A1 12/2005 Fernandes et al.
2006/0007943 A1 1/2006 Fellman
2006/0013263 A1 1/2006 Fellman
2006/0013469 A1 1/2006 Wang et al.
2006/0014388 A1 1/2006 Wang et al.
2006/0029065 A1 2/2006 Fellman
2006/0047365 A1 3/2006 Ghodoussi et al.
2006/0048286 A1 3/2006 Donato
2006/0052676 A1* 3/2006 Wang et al. 600/300
2006/0052684 A1 3/2006 Takahashi et al.
2006/0064212 A1 3/2006 Thorne
2006/0074525 A1 4/2006 Close et al.
2006/0082642 A1 4/2006 Wang et al.
2006/0087746 A1 4/2006 Lipow
2006/0095158 A1 5/2006 Lee et al.
2006/0095170 A1 5/2006 Yang et al.
2006/0098573 A1 5/2006 Beer et al.
2006/0103659 A1 5/2006 Karandikar et al.
2006/0104279 A1 5/2006 Fellman et al.
2006/0106493 A1 5/2006 Niemeyer et al.
2006/0122482 A1 6/2006 Mariotti et al.
2006/0125356 A1* 6/2006 Meek et al. 312/215
2006/0142983 A1 6/2006 Sorensen
2006/0161303 A1 7/2006 Wang et al.
2006/0164546 A1 7/2006 Adachi et al.
2006/0173712 A1 8/2006 Joubert
2006/0178776 A1 8/2006 Feingold et al.
2006/0189393 A1 8/2006 Edery
2006/0195569 A1 8/2006 Barker
2006/0259193 A1 11/2006 Wang et al.
2006/0293788 A1 12/2006 Pogodin
2007/0021871 A1 1/2007 Wang et al.
2007/0046237 A1 3/2007 Lakshmanan et al.
2007/0050937 A1 3/2007 Song et al.
2007/0064092 A1 3/2007 Sandbeg et al.
2007/0078566 A1 4/2007 Wang et al.
2007/0112700 A1 5/2007 Den et al.
2007/0117516 A1 5/2007 Saidi et al.
2007/0120965 A1 5/2007 Sandberg et al.
2007/0122783 A1 5/2007 Habashi
2007/0135967 A1 6/2007 Jung et al.
2007/0142964 A1 6/2007 Abramson
2007/0176060 A1 8/2007 White et al.
2007/0192910 A1 8/2007 Vu et al.
2007/0197896 A1 8/2007 Moll et al.
2007/0198128 A1 8/2007 Ziegler et al.
2007/0199108 A1 8/2007 Angle et al.
2007/0216347 A1 9/2007 Kaneko et al.
2007/0250212 A1 10/2007 Halloran et al.
2007/0262884 A1 11/2007 Goncalves et al.
2007/0273751 A1 11/2007 Sachau
2007/0291109 A1 12/2007 Wang et al.
2007/0291128 A1 12/2007 Wang et al.
2008/0011904 A1 1/2008 Cepollina et al.
2008/0065268 A1 3/2008 Wang et al.
2008/0082211 A1 4/2008 Wang et al.
2008/0133052 A1 6/2008 Jones et al.
2008/0201017 A1 8/2008 Wang et al.
2008/0215987 A1 9/2008 Alexander et al.
2008/0229531 A1 9/2008 Takida
2008/0255703 A1 10/2008 Wang et al.
2008/0263451 A1 10/2008 Portele et al.
2008/0269949 A1 10/2008 Norman et al.
2008/0281467 A1 11/2008 Pinter
2009/0030552 A1 1/2009 Nakadai et al.
2009/0044334 A1* 2/2009 Parsell et al. 5/424
2009/0055023 A1 2/2009 Walters et al.
2009/0105882 A1 4/2009 Wang et al.
2009/0125147 A1 5/2009 Wang et al.
2009/0237317 A1 9/2009 Rofougaran
2009/0240371 A1 9/2009 Wang et al.
2009/0259339 A1 10/2009 Wright et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0010672	A1	1/2010	Wang et al.	
2010/0010673	A1	1/2010	Wang et al.	
2010/0019715	A1	1/2010	Roe et al.	
2010/0051596	A1 *	3/2010	Diedrick et al.	219/137.2
2010/0070079	A1	3/2010	Mangaser et al.	
2010/0073490	A1	3/2010	Wang et al.	
2010/0076600	A1	3/2010	Cross et al.	
2010/0115418	A1	5/2010	Wang et al.	
2010/0116566	A1	5/2010	Ohm et al.	
2010/0131103	A1	5/2010	Herzog et al.	
2010/0191375	A1	7/2010	Wright et al.	
2010/0268383	A1	10/2010	Wang et al.	
2010/0323783	A1	12/2010	Nonaka et al.	
2011/0050841	A1	3/2011	Wang et al.	
2011/0071702	A1	3/2011	Wang et al.	
2011/0172822	A1	7/2011	Ziegler et al.	
2011/0187875	A1	8/2011	Sanchez et al.	
2011/0190930	A1	8/2011	Hanrahan et al.	
2011/0218674	A1 *	9/2011	Stuart et al.	700/259
2011/0245973	A1	10/2011	Wang et al.	
2011/0292193	A1	12/2011	Wang et al.	
2011/0301759	A1	12/2011	Wang et al.	
2012/0023506	A1	1/2012	Maeckel et al.	
2012/0072023	A1	3/2012	Ota	
2012/0092157	A1	4/2012	Tran	
2012/0191464	A1 *	7/2012	Stuart et al.	705/2

FOREIGN PATENT DOCUMENTS

CN	1554985	A	12/2004
CN	101106939	A	1/2008
CN	101390098	A	3/2009
CN	101507260	A	8/2009
CN	101730894	A	6/2010
CN	101866396	A	10/2010
CN	101978365	A	2/2011
CN	102203759	A	9/2011
CN	101106939	B	11/2011
EP	0 466 492	A2	1/1992
EP	92/488673	A2	6/1992
EP	09 81905	B1	2/2002
EP	1 262 142	A2	12/2002
EP	1 536 660	B2	9/2004
EP	1 536 660	A2	6/2005
EP	2005/1573406	A2	9/2005
EP	2005/1594660	A2	11/2005
EP	2007/1791464	A2	6/2007
EP	2007/1800476	A2	6/2007
EP	2007/1856644	A2	11/2007
EP	2008/1928310	A2	6/2008
EP	2009/2027716	A2	2/2009
EP	2010/2145274	A1	1/2010
EP	2010/2214111	A2	8/2010
EP	2010/2263158	A2	12/2010
EP	2011/2300930	A2	3/2011
EP	2011/2342651	A2	7/2011
JP	2007-213753	A	8/1995
JP	2007-248823	A	8/1995
JP	07-257422	A	10/1995
JP	08-084328	A	3/1996
JP	96/8320727	A	12/1996
JP	9-267276	A	10/1997
JP	10079097	A	3/1998
JP	10288689	A	10/1998
JP	2000-032319	A	1/2000
JP	2000/049800	A	2/2000
JP	2000/079587	A	3/2000
JP	2000/196876	A	7/2000
JP	2000-235423	A	8/2000
JP	2001/125641	A	5/2001
JP	2001-147718	A	5/2001
JP	2001/179663	A	7/2001
JP	2001-198865	A	7/2001
JP	2001-198868	A	7/2001
JP	2001-199356	A	7/2001
JP	2000-188124		1/2002
JP	2002-000574	A	1/2002
JP	2002-046088	A	2/2002
JP	2002/101333	A	4/2002
JP	2002/112970	A	4/2002
JP	2002-305743	A	10/2002
JP	2002-355779	A	12/2002
JP	2004/524824	T	8/2004
JP	2004/261941	A	9/2004
JP	2004/2898379	A	10/2004
JP	2005/028066	A	2/2005
JP	2005/059170	A	3/2005
JP	2006/508806	A	3/2006
JP	2006/109094	A	4/2006
JP	2006/224294	A	8/2006
JP	2006/246438	A	9/2006
JP	2007/081646	A	6/2007
JP	2010/064154	A	3/2010
JP	2010/532109	A	9/2010
JP	2010/246954	A	11/2010
KR	2006/0037979	A	5/2006
KR	2009/0012542	A	2/2009
KR	2010/0019479	A	2/2010
KR	2010/0139037	A	12/2010
WO	WO 93/06690	A1	4/1993
WO	WO 98/51078	A	11/1998
WO	WO 99/67067	A1	12/1999
WO	00/33726	A3	6/2000
WO	WO 03/077745	A	9/2003
WO	2004/008738	A1	1/2004
WO	2004/012018	A2	2/2004
WO	WO 2004/075456	A	9/2004
WO	2006/012797	A1	2/2006
WO	2006/078611	A1	4/2006
WO	WO 2007/041295	A2	9/2006
WO	2007/041295	A2	4/2007
WO	2007/041038	A1	6/2007
WO	2008/100272	A2	8/2008
WO	2008/100272	A3	10/2008
WO	2009/117274	A2	9/2009
WO	2009/128997	A1	10/2009
WO	2009/145958	A2	12/2009
WO	2010/006205	A1	1/2010
WO	2010/006211	A1	1/2010
WO	2010/033666	A1	3/2010
WO	2010/047881	A1	4/2010
WO	2010/062798	A1	6/2010
WO	2010/065257	A1	6/2010
WO	2010/120407	A1	10/2010
WO	2011/028589	A2	3/2011
WO	2011/028589	A3	4/2011
WO	2011/097130	A2	8/2011
WO	2011/097132	A2	8/2011
WO	2011/109336	A2	9/2011
WO	2011/097132	A3	12/2011
WO	2011/149902	A2	12/2011

OTHER PUBLICATIONS

Bauer, et al., "Remote telesurgical mentoring: feasibility and efficacy", IEEE, 2000, pp. 1-9.

Brooks, "Remote Presence", Abstracts from Flesh & Machines, How Robots Will Change Us, Feb. 2002, pp. 131-147.

Davis, "Meet iRobot, The Smartest Webcam on Wheels," Wired Magazine, 8.09, http://www.wired.com/wired/archive/8.09/irobot_pr.html, Sep. 2000, 2 pgs.

Dean, et al., "1992 AAAI Robot Exhibition and Competition," AI Magazine, Spring 1993, 10 pgs.

"Defendant VGo Communications, Inc.'s Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order", May 2, 2012.

"Defendant-Counterclaimant VGo Communications, Inc.'s Supplemental Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order", May 14, 2012.

Dudenhoeffer, et al., "Command And Control Architectures For Autonomous Micro-Robotic Forces", http://www.inl.gov/technicalpublications/Documents/3157051.pdf, Apr. 2001.

Elhajj, "Real-Time Haptic Feedback in Internet-Based Telerobotic Operation", IEEE International Conference on Electro/Information

(56) **References Cited**

OTHER PUBLICATIONS

Technology, http://www.egr.msu.edu/~ralab-web/cgi_bin/internet-teleoperation.php, Jun. 2000.
Fong, "Collaborative Control: A Robot-Centric Model for Vehicle Teleoperation", The Robotics Institute Carnegie Mellon University, http:web.archive.org/web/200305040803/www.ricmu.edu/cgi-bin/tech_reports.cgi?year=2001&text=0, Nov. 2001.
Grow, "Office Coworker Robot," Time Magazine, http://www.time.com/time/specials/packages/article/0,28804,1936165_1936255_1936640,00.html, Nov. 19, 2001, 2 pgs.
ITU, "ITU-T H.281 A Far End Camera Control Protocol For Videoconferences using H.224", http://www.itu.int/rec/T-RECH.281-199411-I/en, Nov. 1994.
ITU, "ITU-T H.450.11 Call Intrusion Supplementary Service for H.323", http://www.itu.int/rec/T-RECH.450.11-200103-I/en, Mar. 2001.
ITU, "ITU-T H.450.9 Call Completion Supplementary Services for H.323", http://www.itu.int/rec/T-RECH.450.9-200011-I/en, Nov. 2000.
Knight, et al., "Active Visual Alignment of a Mobile Stereo Camera Platform", Proceedings of the IEEE, International Conference on Robotics and Automation, San Francisco, Apr. 24-28, 2000, pp. 3202-3208.
Metz, "HP Labs", PCMAG.com, http://www.pcmag.com/article2/0,2817,1130820,00.asp, Jul. 1, 2003.
"PictureTel Adds New Features And Functionality To Its Award-Winning Live200 Desktop Videoconferencing System", PR Newswire Association, LLC, Gale, Cengange Learning, http://www.thefreelibrary.com/PictureTel+Adds+New+Features+And+Functionality+To+Its+Award-Winning...-a019512804, Jun. 13, 1997.
Picturetel, "PictureTel Live200 for Windows NT Product Guide", http://support.polycom.com/global/documents/support/user/products/video/live200_live200NT_product_guide.pdf, Nov. 1994.
Roach, "Automatic Call Back Service in SIP", http://tools.ietf.org/pdf/draftroach-sip-acb-00.pdf, Mar. 2000.
Summers, "Microsoft NetMeeting 3 Features excerpt from Official Microsoft NetMeeting 3.0 Book", http://technet.microsoft.com/en-us/library/cc723477.aspx#XSLTsection121121120120, excerpt from Microsoft Press http://www.computerbooksonline.com/abook.asp?i=0735605823, Mar. 1999.
U.S. Appl. No. 10/783,760, filed Feb. 20, 2004, Wang, et al., 48 pgs.
U.S. Appl. No. 60/449,762, filed Feb. 24, 2003, Wang, et al., 28 pgs.
Weiss, et al., "PEBBLES: A Personal Technology for Meeting Education, Social and Emotional Needs of Hospitalised Children", Personal and Ubiquitous Computing 5, Springer-Verlag London Ltd., 2001, pp. 157-168.
Zambroski, "CMU, Pitt Developing 'nursebot'", http://www.cs.cmu.edu/~nursebot/web/press/tribunereview.html, Oct. 27, 2000.
Al-Kassab, "A Review of Telemedicine", Journal of Telemedicine and Telecare, 1999, vol. 5, Supplement 1.
F. Ando et al., "A Multimedia Self-service Terminal with Conferencing Functions", 1995, IEEE, pp. 357-362.
Android Amusement Corp., "What Marketing Secret . . . Renting Robots from Android Amusement Corp!", (Advertisement) 1982.
Applebome, "Planning Domesticated Robots for Tomorrow's Household", New York Times, Mar. 4, 1982, pp. 21 and 23, http://www.theoldrobots.com/images17/dc17.JPG.
Baltus et al., "Towards Personal Service Robots for the Elderly, Proceedings for the Elderly Workshop on Interactive Robots and Entertainment", 2000, Computer Science and Robotics, http://www.cs.cmu.edu/thrun/papers/thrun.nursebot-early.pdf.
Bar-Cohen et al., Virtual reality robotic telesurgery simulations using MEMICA haptic system, Mar. 5, 2001, Internet, pp. 1-7.
Bartholomew, "An Apothecary's Pharmacy", 1230-1240 http://classes.bnf.fr/ema/grands/034.htm.
Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", Jun. 2003.
Bauer, John et al., "Remote telesurgical mentoring: feasibility and efficacy", 2000, IEEE, pp. 1-9.
Bischoff, "Design Concept and Realization of the Humanoid Service Robot HERMES", Field and Service Robotics, Springer, London, 1998, pp. 485-492.
Blackwell, Gerry, "Video: A Wireless LAN Killer App?", Apr. 16, 2002, Internet pp. 1-3.
Breslow, Michael J., MD et al., "Effect of a multiple-site intensive care unit telemedicine program on clinical and economic outcome: An alternative paradigm for intensivist staffing", Critical Care Med, Jan. 2004, vol. 32, No. 1, pp. 31-38.
Brooks, Rodney, Abstracts from Flesh & Machines, How Robots Will Change Us, "Remote Presence", p. 131-147, Feb. 2002.
Candelas Herias, F.A. et al., "Flexible virtual and remote laboratory for teaching Robotics", FORMATEX 2006, Proc. Advance in Control Education, Madrid, Spain, Jun. 21-23, 2006.
Celi et al., "The eICU: It's not just telemedicine", Critical Care Medicine, vol. 29, No. 8 (Supplement), Aug. 2001.
Cheetham, Anastasia et al., "Interface Development for a Child's Video Conferencing Robot", 2000, pp. 1-4.
Cleary et al., "State of the art in surgical robotics: Clinical applications and technology challenges", Feb. 24, 2002 Internet, pp. 1-26.
CNN, "Floating 'droids' to roam space corridors of the future", Jan. 12, 2000, Internet, pp. 1-4.
CNN.com/Technology,"Paging R.Robot: Machine helps doctors with patients", Sep. 30, 2003, Internet, 1-3.
Crowley, "Hello to Our Future", AARP Bulletin, Jan. 2000 http://www.cs.cmu.ed/-nursebot/web/press/aarp_99_14/millennium.html.
Dalton, "Techniques for Web Telerobotics", PhD Thesis, University of Western Australia, 2001, pp. 27-62, 149-191; http://telerobot.mech.uwa.edu.au/information.html, http://catalogue.library.uwa.edu.au/search.
Davies, "Robotics in Minimally Invasive Surgery", 1995, Internet, pp. May 1-2.
DiGiorgio, James, "Is Your Emergency Department of the 'Leading Edge'?", 2005, Internet, pp. 1-4.
Discovery Channel Canada, "Inventing the Future: 2000 Years of Discovery", Jan. 2, 2000 (Video/Transcript).
Elhajj et al., "Supermedia in Internet-based telerobotic operations", 2001, Internet, pp. 1-14.
Elhajj et al., "Synchronization and Control of Supermedia Transmission Via the Internet", Proceedings of 2001 International Symposium on Intelligent Multimedia, Video and Speech Processing, May 2-4, 2001, Hong Kong.
Ellison et al., "Telerounding and Patient Satisfaction Following Surgery".
Fels, "Developing a Video-Mediated Communication System for Hospitalized Children", Telemedicine Journal, vol. 5, No. 2, 1999.
Fetterman, "Videoconferencing over the Internet", 2001, Internet, pp. 1-8.
Fiorini, "Health Care Robotics: A Progress Report", IEEE International Conference on Robotics and Automation, pp. 1271-1276, Apr. 1997.
Ghiasi, "A Generic Web-based Teleoperations Architecture: Details and Experience", SPIE Conference on Telemanipulator and Telepresence Technologies VI, Sep. 1999.
Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation, Apr. 2000, San Francisco, California.
Goldberg, "Desktop Teleoperation via the World Wide Web, Proceedings of the IEEE International Conference on Robotics and Automation", 1995, pp. 654-659 http://citeseer.ist.psu.edu/cache/papers/cs/5/ftp:zSzzSzusc.eduzSzpubzSziriszSzraiders.pdf/gol.
Goldberg, "More Online Robots, Robots that Manipulate", Internet, Updated Aug. 2001 http://ford.ieor.berkeley.edu/ir/robots_a2.html.
Goldenberg, et al., "Telemedicine in Otolaryngology", American Journal of Otolaryngology, vol. 23, No. 1, 2002, pp. 35-43.
Goldman, Lea, "Machine Dreams", Entrepreneurs, Forbes, May 27, 2002.
Gump, Michael D., "Robot Technology Improves VA Pharmacies", 2001, Internet, pp. 1-3.

(56) **References Cited**

OTHER PUBLICATIONS

Han, et al., "Construction of an Omnidirectional Mobile Robot Platform Based on Active Dual-Wheel Caster Mechanisms and Development of a Control Simulator", 2000, Kluwer Acedemic Publishers, vol. 29, pp. 257-275.
Handley, "RFC 2327—SDP: Session Description Protocol", Apr. 1998 http://www.faqs.org/rfcs/rfc2327.html.
Hanebeck, "ROMAN: a mobile Robotic Assistant for Indoor Service Applications", Proceedings of the 1997 IEEE/RSJ International Conference on Intelligent Robots and Systems, 1997.
Harmo et al., "Moving Eye—Interactive Telepresence Over Internet With a Ball Shaped Mobile Robot", 2000.
Haule et al., "Control Scheme for Delayed Teleoperation Tasks", May 17, 1995, Proceedings of the Pacific Rim Conference on Communications, Computer and Signal Processing.
Hees, William P., "Communications Design for a Remote Presence Robot", Jan. 14, 2002.
Holmberg, "Development of a Holonomic Mobile Robot for Mobile Manipulation Tasks", International Conference on Field and Service Robotics, Pittsburgh, PA, Aug. 1999.
Ishiguro, "Integrating a Perceptual Information Infrastructure with Robotic Avatars: A Framework for Tele-Existence" Proceeding of IEEE Conference on Intelligent Robots and Systems, http://www.ai.soc.i.kyoto-u.ac.jp/services/publications/99/99conf/07.pdf.
Ishihara, Ken et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Nov. 3-5, 1991, IEEE/RSJ, pp. 1145-1150, vol. 2.
Itu, "ITU-T H.323 Packet-based multimedia communications", ITU, Feb. 1998, http://www.itu.int/rec/T-REC-H.323-199802-S/en.
Ivanova, Natali, "Master's thesis: Internet Based Interface for Control of a Mobile Robot", Department of Numerical Analysis and Computer Science.
Jenkins, "Telehealth Advancing Nursing Practice", Nursing Outlook, Mar./Apr. 2001, vol. 49, No. 2.
Johanson, "Supporting video-mediated communication over the Internet", Chalmers University of Technology, Dept of Computer Engineering, Gothenburg, Sweden, 2003.
Jouppi, et al., "Mutually-Immersive Audio Telepresence", Audio Engineering Society Convention Paper, presented at 113th Convention Oct. 2002.
Jouppi, Norman P., "First Steps Towards Mutually-Immersive Mobile Telepresence", CSCW '02, Nov. 16-20, 2002, New Orleans LA.
Kanehiro, Fumio et al., "Virtual Humanoid Robot Platform to Develop Controllers of Real Humanoid Robots without Porting", 2001, IEEE, pp. 3217-3276.
Kaplan et al., "An Internet Accessible Telepresence".
Keller et al., "Raven Interface Project", Fall 2001 http://upclose.lrdc.pitt.edu/people/louw_assets/Raven_Slides.pps.
Khatib, "Robots in Human Environments", Proc. International Conference on Control, Automation, Robotics, and Vision , ICRACV2000, Dec. 2000, Singapore, pp. 454-457.
Kuzuoka et al., "Can the GestureCam Be a Surrogate?".
Lane, "Automated Aides", Newsday, Oct. 17, 2000, http://www.cs.cum.edu/-nursebot/web/press/nd4380.htm.
Lee et al., "A novel method of surgical instruction: International telementoring", 1998, Internet pp. 1-4.
Lim, Hun-ok et al., "Control to Realize Human-like Walking of a Biped Humanoid Robot", IEEE 2000, pp. 3271-3276.
Linebarger, John M. et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Presence, Special Issue on Advances in Collaborative VEs (2004).
Loeb, Gerald, "Virtual Visit: Improving Communication for Those Who Need It Most", 2001.
Long, "HelpMate Robotics, Inc. (Formerly Transitions Research Corporation) Robot Navigation Technology", NIST Special Publication 950-1, Mar. 1999, http://www.atp.nist.gov/eao/sp950-1/helpmate.htm.
Luna, Nancy, "Robot a new face on geriatric care", OC Register, Aug. 6, 2003.
Mack, "Minimally invasive and robotic surgery", 2001, Internet IEEE, pp. 568-572.
Mair, "Telepresence—The Technology And Its Economic and Social Implications", IEEE Technology and Society, 1997.
Martin, Anya, "Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.
McCardle et al., "The challenge of utilizing new technology in design education", 2000 Internet, pp. 122-127.
Meng et al., "E-Service Robot in Home Healthcare", Proceedings of the 2000 IEEE/RSJ, International Conference on Intelligent Robots and Systems, 2000, pp. 832-837.
Michaud, "Introducing 'Nursebot'", The Boston Globe, Sep. 11, 2001, pp. 1-5, http://www.cs.cmu.edu/nursebot/web/press/globe_3_01/index.html.
Mobile Robotics Research Group, "Mobile Robotics Research Group", 2000 Internet, pp. 1-2, Edinburgh.
Montemerlo, "Telepresence: Experiments in Next Generation Internet", CMU Robotics Institute, Oct. 20, 1998, http://www.ri.cmu.edu/creative/archives.htm (Video/Transcript).
Murphy, "Introduction to A1 Robotics", 2000.
Nakajima et al., "A Multimedia Teleteaching System sing an Electronic Whiteboard for Two-Way Communication of Motion Videos and Chalkboards", 1993, IEEE, pp. 436-441.
"National Energy Research Scientific Computing Center, Berkeley Lab's RAGE Telepresence Robot Captures R&D100 Award", Jul. 2, 2002, http://www.nersc.gov/news/newsroom/RAGE070202.php.
Nomadic Technologies, Inc., "Nomad XR4000 Hardware Manual", Mar. 1999.
Ogata et al., "Emotional Communication Robot: WAMOEBA-2R—Emotion Model and Evaluation Experiments", 1999, Internet, pp. 1-16.
Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2r—Experimental evaluation . . . ", 2000 IEEE, pp. 175-180.
Oh et al., "Autonomous Battery Recharging for Indoor Mobile Robots", Proceedings of Australian Conference on Robotics and Automation, 2000, http://users.rsise.anu.edu.au/rsl/rsl_papers/ACRA2000/Auto_Recharge_Paper.pdf.
Ojha, Anad, "An application of Virtual Reality in Rehabilitation", Jan. 1994, IEEE, pp. 4-6.
Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", http://vive.cs.berkeley.edu/capek, 1995.
Paulos, "Designing Personal Tele-embodiment", IEEE International Conference on Robotics and Automation, 1998, http://www.prop.org/papers/icra98.pdf.
Paulos, Eric John, "Personal Tele-Embodiment", UC Berkeley, Fall 2001.
Paulos, "PRoP: Personal Roving Presence", ACM:CHI Proceedings of CHI '98, http://www.prop.org/papers/chi98.pdf.
Paulos, Video of PRoP 2 at Richmond Field Station, www.prop.org. May 2001, Printout of Home Page of Website and two-page Transcript of the audio portion of said PRoP Video.
Paulos, et al. , "Ubiquitous Tele-embodiment: Applications and Implications", International Journal of Human Computer Studies, Jun. 1997, vol. 46, No. 6, pp. 861-877.
Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE, vol. 10, No. 4, Aug. 1994.
Rovetta et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and Optical Fiber Networks for Data Exchange", Jun. 1, 1996, International Journal of Robotics Research, pp. 267-279.
Roy et al., "Towards Personal Service Robots for the Elderly", Internet, Mar. 7, 2002.
Salemi et al, "MILO: Personal robot platform", 2005, Internet, pp. 1-6.
Sandt, Frederic et al., "Perceptions for a Transport Robot in Public Environments", 1997, IROS '97.
Schaeffer, "Care-O-bot: A System for Assisting Elderly or Disabled Persons in Home Environments", Proceedings of AAATE-99, 1999,

(56) **References Cited**

OTHER PUBLICATIONS

http://morpha.de/download/publications/IPA_Systems_For_AssistingElderly_or_DisabledPersons_AAATE1999.pdf.
Schulz, "Web Interfaces for Mobile Robots in Public Places", Robotics & Automation Magazine, IEEE, vol. 7, Issue 1, Mar. 2000.
Shimoga et al., Touch and force reflection for telepresence surgery, 1994, IEEE, pp. 1049-1050.
Siegwart, "Interacting Mobile Robots on the Web", Proceedings of the 1999 IEEE International Conference on Robotics and Automation, May 1999.
Simmons, "Xavier: An Autonomous Mobile Robot on the Web", IEEE Robotics and Automation Magazine, 1999, pp. 43-48.
Spawar Systems Center, "Robart", 1998, San Diego, CA, http://web.archive.org/web/*/http://www.nosc.mil/robots/land/robart/robart.html http://web.archive.org/web/19981202205636/http://www.nosc.mil/robots/land/robart/robart.html.
Stephenson, Gary, "Dr. Robot Tested at Hopkins", Aug. 5, 2003, Internet, pp. 1-2.
Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Dec. 2002, Internet, 1-17.
Suplee, "Mastering the Robot", The Washington Post, p. A01, Sep. 17, 2000 http://www.cs.cmu.edu-nursebot/web/press/wash/index.html.
Tahboub, Karim A. et al., "Dynamics Analysis and Control of a Holonomic Vehicle With Continously Variable Transmission", Mar. 2002, Journal of Dynamic Systems, Measurement, and Control, ASME vol. 124, pp. 118-126.
Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", 1997, IEEE, pp. 2771-2776.
Thrun et al, "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", 2000, Internet pp. 1-35.
Tzafestas, et al., "VR-based Teleoperation of a Mobile Robotic Assistant: Progress Report", Nov. 2000, Internet, pp. 1-23.
Urquhart, Kim, "InTouch's robotic Companion 'beams up' healthcare experts", Medical Device Daily, vol. 7, No. 39, Feb. 27, 2003, p. 1, 4.
Weiss et al., Telework and video-mediated communication: Importance of real-time, interactive communication for workers with disabilities, pp. 1-4, California State University Northridge, http://www.csun.edu/cod/conf/1999/proceedings/session0238.html.
West et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design, vol. 119, pp. 153-161, Jun. 1997.
Yamasaki et al., Applying Personal Robots and Active Interface to Video Conference Systems, 1995, Internet, pp. 243-248.
Yamauchi et al., PackBot: A Versatile Platform for Military Robotics, 2004, Internet, pp. 1-10.
Yong et al., "Robot task execution with telepresence using virtual reality technology", 1998, Internet, pp. 1-9.
Zamrazil, Kristie, "Telemedicine in Texas: Public Policy Concerns", House Research Organization Focus Report, Texas House of Representatives, No. 76-22, May 5, 2000 http://www.hro.house.state.tx.us/focus/telemed.pdf.
Zipperer, Lorri, "Robotic dispensing system", 1999, Internet, pp. 1-2.
Zorn, Benjamin G., "Ubiquitous Telepresence", http://www.cs.colorado.edu/~zorn/ut/vision/vision.html, Mar. 5, 1996.

* cited by examiner

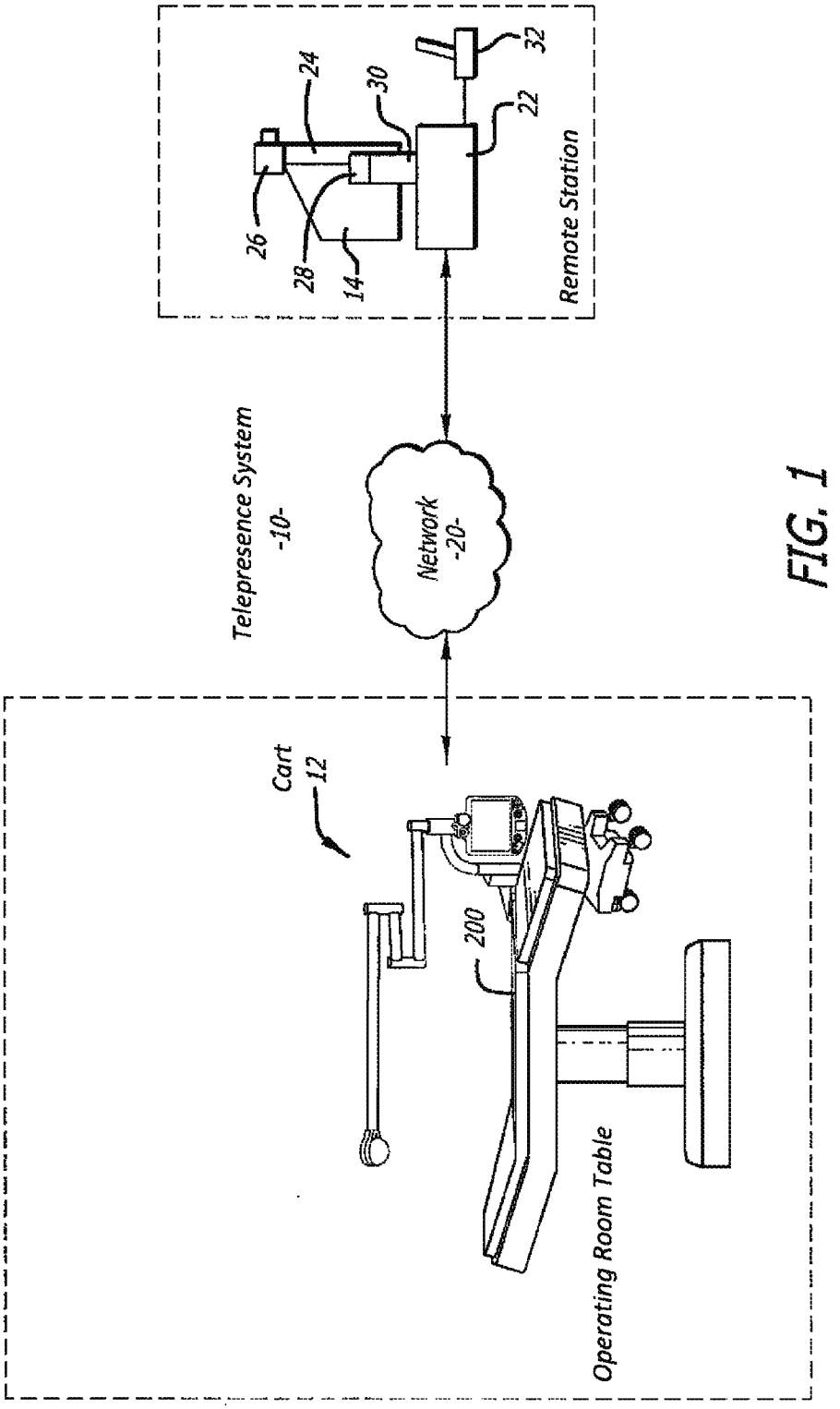

Remote Station
32
24
30
22
26
28
14
Telepresence System
-10-
Network
-20-
Cart
12
200
Operating Room Table

FIG. 1

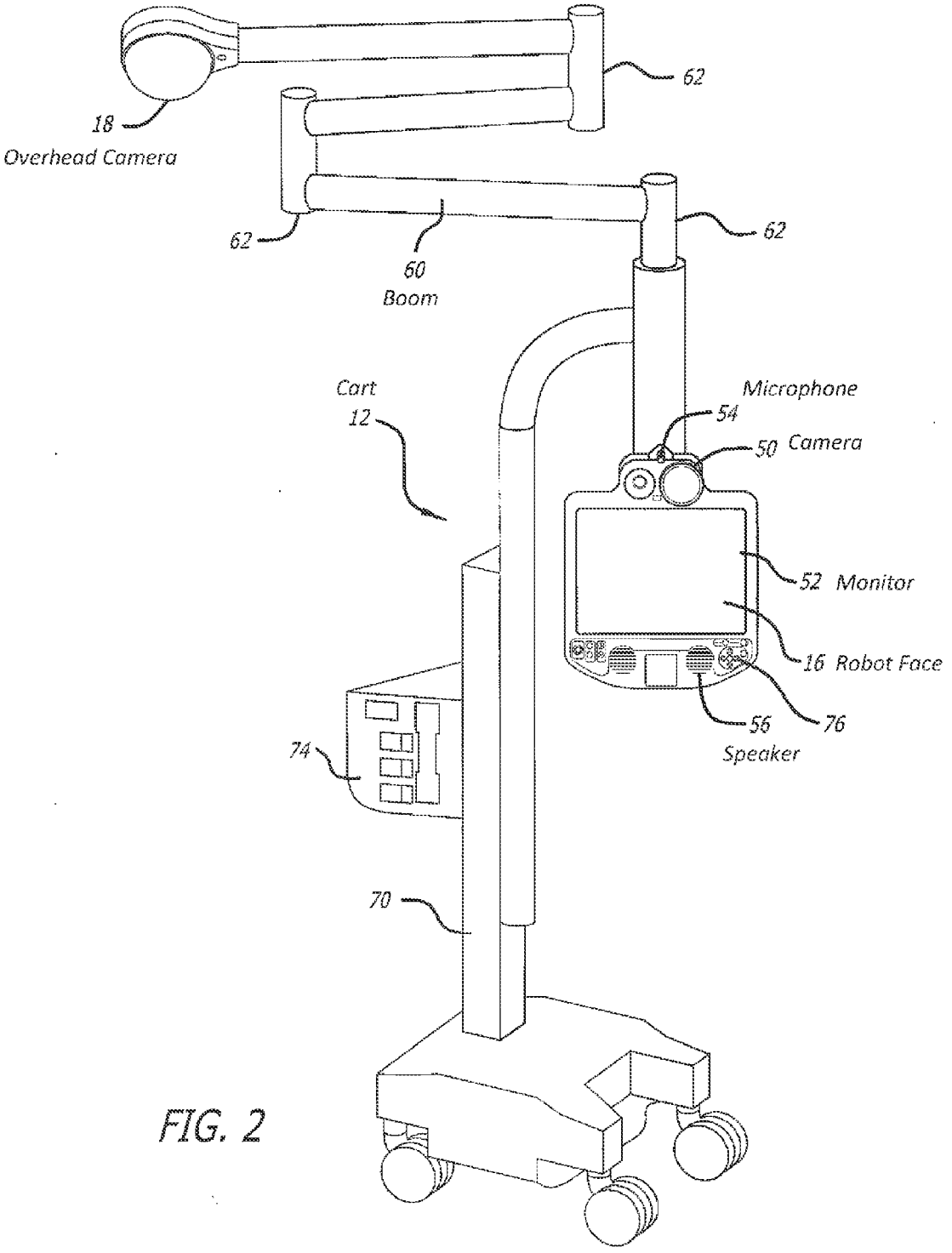

18
Overhead Camera
62
62
62
60
Boom
Cart
12
Microphone
54
50
Camera
52
Monitor
16
Robot Face
56
76
Speaker
74
70

FIG. 2

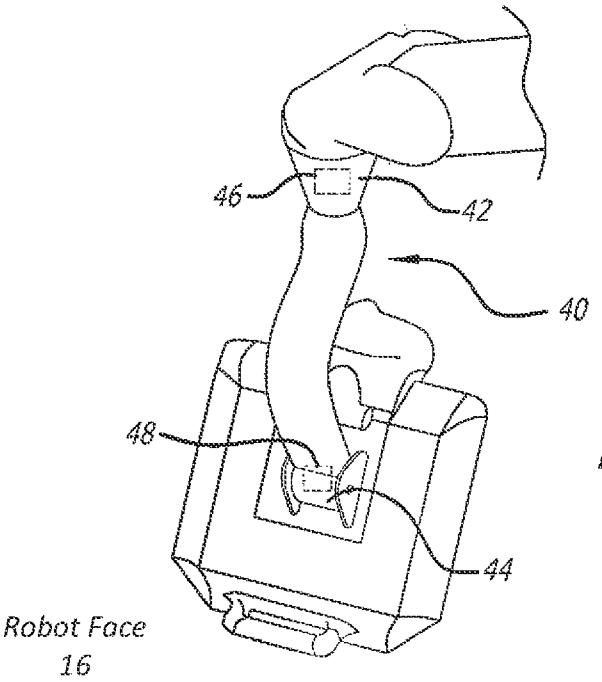


FIG. 3

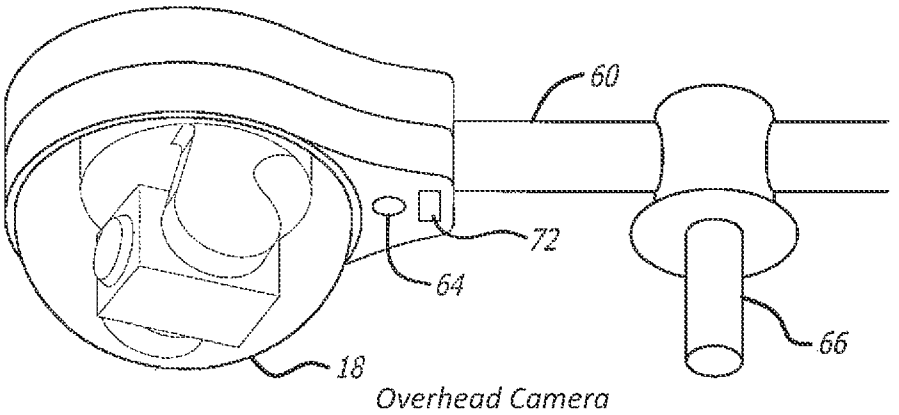


FIG. 4

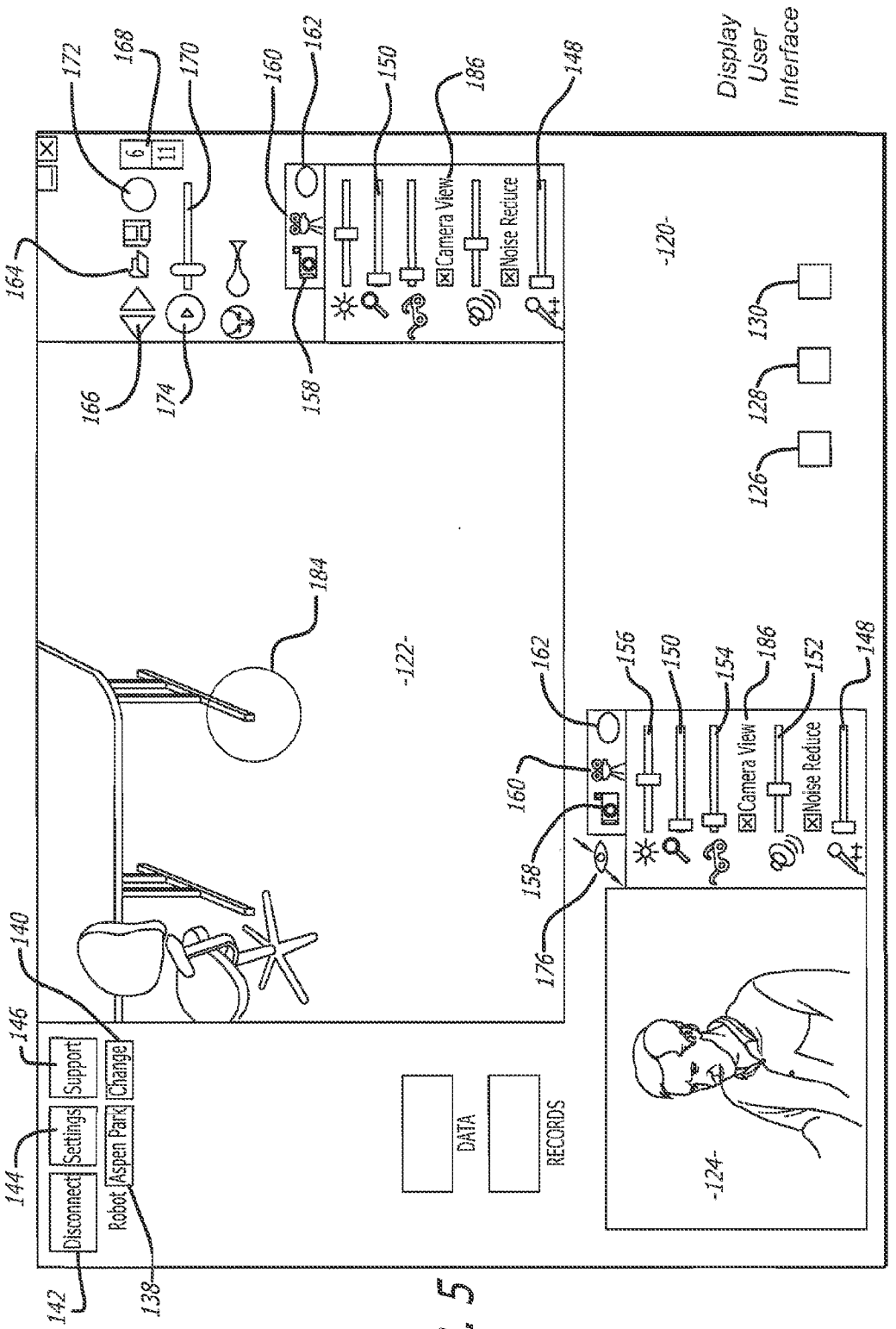
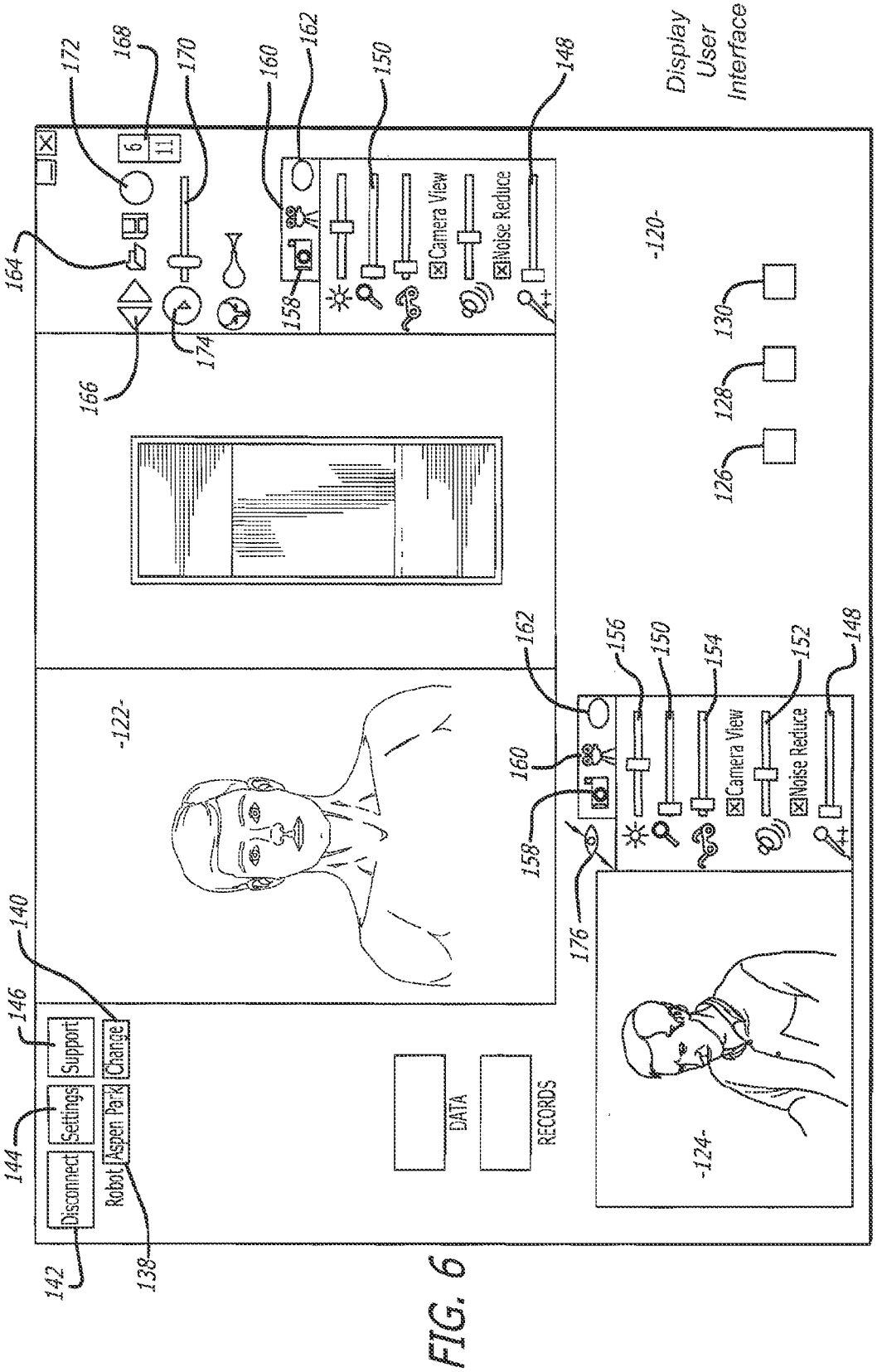

Display User Interface
Camera View
Noise Reduce
-120-
-122-
-124-
DATA
RECORDS
Disconnect
Settings
Robot
Aspen Park
Support
Change
172
168
170
160
162
150
186
148
164
166
174
158
130
128
126
184
156
154
152
140
146
144
142
138
176

FIG. 5


Display User Interface
-120-
-122-
-124-
Camera View
Noise Reduce
Support
Change
Settings
Disconnect
Robot
Aspen Park
DATA
RECORDS
138
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168
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176
126
128
130

FIG. 6

REMOTE PRESENCE SYSTEM INCLUDING A CART THAT SUPPORTS A ROBOT FACE AND AN OVERHEAD CAMERA

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the field of robotic tele-presence systems.

2. Background Information

Robots have been used in a variety of applications ranging from remote control of hazardous material to assisting in the performance of surgery. For example, U.S. Pat. No. 5,762,458 issued to Wang et al. discloses a system that allows a surgeon to perform minimally invasive medical procedures through the use of robotically controlled instruments. One of the robotic arms in the Wang system moves an endoscope that has a camera. The camera allows a surgeon to view a surgical area of a patient.

There has been marketed a mobile tele-presence robot introduced by InTouch Technologies, Inc., the assignee of this application, under the trademark RP-7. The InTouch robot is controlled by a user at a remote station. The remote station may be a personal computer with a joystick that allows the user to remotely control the movement of the robot. Both the robot and remote station have cameras, monitors, speakers and microphones to allow for two-way video/audio communication. The robot camera provides video images to a screen at the remote station so that the user can view the robot's surroundings and move the robot accordingly.

InTouch also provides a system sold as VisitOR that includes a robot face that is attached to a boom. The boom and robot face can be installed into an operating room. Using a robot face in an operating room may require sterilization of the face. Additionally, the VisitOR requires the installation of a boom in the operating room. This can add to the cost and complexity of installing such a system.

BRIEF SUMMARY OF THE INVENTION

A tele-presence system that includes a cart. The cart includes a robot face that has a robot monitor, a robot camera, a robot speaker, a robot microphone, and an overhead camera. The system also includes a remote station that is coupled to the robot face and the overhead camera. The remote station includes a station monitor, a station camera, a station speaker and a station microphone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a tele-presence system;

FIG. **2** is a perspective view of a cart of the system;

FIG. **3** is a rear view of an articulated arm and a robot face of the cart;

FIG. **4** is an enlarged perspective view of an overhead camera of the cart;

FIG. **5** is an illustration of a display user interface of a remote station;

FIG. **6** is an illustration of the display user interface showing video images captured by a robot camera and an overhead camera being simultaneously displayed.

DETAILED DESCRIPTION

Disclosed is a tele-presence system that includes a cart. The cart includes a robot face that has a robot monitor, a robot camera, a robot speaker, a robot microphone, and an overhead camera. The system also includes a remote station that is coupled to the robot face and the overhead camera. The remote station includes a station monitor, a station camera, a station speaker and a station microphone. The remote station can display video images captured by the robot camera and/or overhead camera. By way of example, the cart can be used in an operating room, wherein the overhead camera can be placed above a sterile field to provide a more advantageous vantage point to view a procedure. The user at the remote station can conduct a teleconference through the robot face and also obtain a view of a medical procedure through the overhead camera.

Referring to the drawings more particularly by reference numbers, FIGS. **1**, **2** and **3** show a tele-presence system **10**. The system **10** includes a cart **12** that is coupled to a remote control station **14**. The cart **12** has a robot face **16** and an overhead camera **18**. The remote control station **14** may be coupled to the cart **12** through a network **20**. By way of example, the network **20** may be either a packet switched network such as the Internet, or a circuit switched network such as a Public Switched Telephone Network (PSTN) or other broadband system. Alternatively, the cart **12** may be coupled to the remote station **14** network thru a satellite.

The remote control station **14** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. The control station **14** is typically located in a place that is remote from the cart **12**. Although only one remote control station **14** is shown, the system **10** may include a plurality of remote stations **14**. In general any number of carts **12** may be coupled to any number of remote stations **14** or other carts **12**. For example, one remote station **14** may be coupled to a plurality of carts **12**, or one cart **12** may be coupled to a plurality of remote stations **14**, or a plurality of carts **12**. The system may include an arbitrator (not shown) that control access between the carts **12** and the remote stations **14**.

As shown in FIG. **3**, the cart **12** may include an articulated arm **40** that supports and can move the robot face **16**. The articulated arm **40** may have active joints **42** and **44** that allow the robot face **16** to be panned and tilted, respectively. The active joints **42** and **44** may move in response to commands provided by the remote station. The joints **42** and **44** may contain position sensors **46** and **48**, respectively, that provide positional feedback of the arm **40**.

Referring to FIGS. **2** and **3**, each robot face **16** includes a camera(s) **50**, a monitor **52**, a microphone(s) **54** and a speaker(s) **56**. The robot camera **50** is coupled to the remote monitor **24** so that a user at the remote station **14** can view a video image captured by the robot camera **50**. Likewise, the robot monitor **52** is coupled to the remote camera **26** so personnel at the surgical site may view the user of the remote station **14**. The microphones **28** and **54**, and speakers **30** and **56**, allow for audible communication between the system operator and the personnel at the surgical site.

The overhead camera **18** may be coupled to a boom **60**. The boom **60** may include a number of joints **62**, either active or passive. The joints **62** may include positional sensors to provide feedback regarding the position of the overhead camera **18**.

As shown in FIG. **4**, the cart **12** may include an overhead microphone **64** and a detachable handle **66**. The overhead microphone **64** may provide an alternative source of sound. The detachable handle **66** can be used to move the boom **60** and overhead camera **18**. If the cart **12** is used in a sterile field, for example in an operating room, the handle **66** may be

replaced with a sterile handle before each medical procedure to allow a surgeon within the sterile field to position the boom during a procedure.

Referring again to FIG. **2**, the cart **12** may include a linear actuator **70** that can be remotely or locally actuated to vary the height of the robot face **16** and overhead camera **18**. Varying the height allows the cart **12** to be rolled through doors and then actuated to move the face **16** and camera **18** to elevated positions. For example, the face **16** and camera **18** can be lowered to allow the cart **12** to be moved into an operating room. The camera **18** can then be raised to provide a desirable view over an operating table. The cart **12** may include a laser pointer **72** and/or directed lighting (not shown) located on the boom **60**. The cart **12** may also include a local control panel **74** to move the articulated arm **40**, actuator **70** and/or boom **60**. The linear actuator **70** is also advantageous in moving the face **16** to be essentially at the same level as a person whether they are standing, sitting or lying in a prone position.

The robot face **16** may include a processor, hard disk drive and other circuits that enable the face **16** to function as a computer. The face **16** may include an input panel **76** that allows a user to provide input. By way of example, the operator of the remote station may provide one or more questions through the robot face **16**, wherein a user of the cart provides answers through the input panel **76**.

The system **10** may have certain components and software that are the same or similar to a robotic system provided by the assignee InTouch Technologies, Inc. of Goleta, Calif. under the name RP-7 and embodies a system described in U.S. Pat. No. 6,925,357, which is hereby incorporated by reference.

FIG. **5** shows a display user interface ("DUI") **120** that can be displayed at the remote station **14**. The DUI **120** may include a robot view field **122** that displays a video image captured by the robot camera and/or the overhead camera. The DUI **120** may also include a station view field **124** that displays a video image provided by the camera of the remote station **14**. The DUI **120** may be part of an application program stored and operated by the computer **22** of the remote station **14**.

The DUI **120** may include a graphical switch **126** that allows the user to select between the video image provided by the robot camera and the video image provided by the overhead camera. The DUI **120** may also have a graphical switch **128** that allows the user to select the simultaneous display of the video images from the robot and overhead cameras as shown in FIG. **6**. The video images from both cameras can be streamed to the remote station from the cart. The images can be merged by presenting a center rectangle of each image (e.g., 320×480 center area). A zoom or highlighting feature may be utilized by manipulating a cursor on either image. The system may also automatically pan a camera when the cursor is moved out of the displayed field of view.

The system may automatically present the video image from a camera that has an optimal view of an object. For example, the system may utilize pattern recognition techniques to determine which video image provides a more clear image of an object. The system may determine which camera is in closer proximity to an object and provide the image from the camera that is closer to the object. The system may utilize positional feedback from the cart to determine the proximity of the cameras relative to the object. The system may also have sensors, such as laser, sonar, etc. that can determine the proximity of the cameras to the object. The system may use the feedback and/or sensors to determine which camera is closer to an object.

The system may automatically move the cameras so that each camera is pointed to the same or substantially the same field of view. For example, if the robot face is pointed toward an object, the overhead camera can be automatically moved to capture a video image of the same object. Likewise, if the overhead camera is capturing a video image of an object, the robot face can be automatically moved to point toward the same object. This enhances the "presence" of the remote operator because they are facing the same object that the overhead camera is viewing.

The DUI **120** may have a graphical switch **130** that allows the user to switch between sound captured by the robot microphone or the overhead microphone. The system may automatically switch between microphones based on a characteristic(s) of the sound captured by the microphones. For example, the system may switch to the microphone that provides the highest aural clarity, or to the microphone that is in the closest proximity to a person or object generating the sound.

The DUI **120** may include a location display **138** that provides the location of the robot face. The CHANGE button **140** can be selected to change the default robot face in a new session. The CHANGE button **140** can be used to select and control a different robot face in a system that has multiple robot faces. The user can initiate and terminate a session by selecting box **142**. The box **142** changes from CONNECT to DISCONNECT when the user selects the box to initiate a session. System settings and support can be selected through buttons **144** and **146**.

Both the robot view field **122** and the station view field **124** may have associated graphics to vary the video and audio displays. Each field may have an associated graphical audio slide bar **148** to vary the audio level of a selected microphone and another slide bar **152** to vary the volume of the speakers.

The DUI **120** may have slide bars **150**, **154** and **156** to vary the zoom, focus and brightness of a selected camera, respectively. A still picture may be taken at either the robot face or remote station by selecting one of the graphical camera icons **158**. The still picture may be the image presented at the corresponding field **122** or **124** at the time the camera icon **158** is selected. Capturing and playing back video can be taken through graphical icons **160**. A return to real time video can be resumed, after the taking of a still picture, captured video, or reviewing a slide show, by selecting a graphical LIVE button **162**.

A still picture can be loaded from disk for viewing through selection of icon **164**. Stored still images can be reviewed by selecting buttons **166**. The number of the image displayed relative to the total number of images is shown by graphical boxes **168**. The user can rapidly move through the still images in a slide show fashion or move through a captured video clip by moving the slide bar **170**. A captured video image can be paused through the selection of circle **174**. Play can be resumed through the same button **174**. Video or still images may be dismissed from the active list through button **172**. Video or still images may be transferred to the robot by selecting icon **176**. For example, a doctor at the remote station may transfer an x-ray to the screen of the robot.

The system may provide the ability to annotate **184** the image displayed in field **122** and/or **124**. For example, a doctor at the remote station may annotate some portion of the image captured by the robot face camera. The annotated image may be stored by the system. The system may also allow for annotation of images sent to the robot face through icon **176**. For example, a doctor may send an x-ray to the robot face which is displayed by the robot screen. The doctor can annotate the x-ray to point out a portion of the x-ray to personnel located at the robot site. This can assist in allowing the doctor to instruct personnel at the robot site.

The display user interface may include graphical inputs **186** that allow the operator to turn the views of the remote station and remote cameras on and off.

Referring to FIG. **1**, the cart **12** can be used in an operating room. By way of example, the boom **60** can be moved to place the overhead camera **18** above an operating table **200**. The overhead camera **18** may be located above a sterile field. The robot face **16** may be placed adjacent to the sterile field. With such a configuration, personnel may conduct two-way video conferencing through the robot face **16**. The overhead camera **18** may provide a more desirable view of the patient and operating procedure. This would allow a physician at the remote station to view the procedure and have a video conference to provide instructions, mentoring, etc. to personnel at the surgical site.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A tele-presence system, comprising:

a cart, said cart includes a robot face that has a robot monitor, a robot camera, a robot speaker, a robot microphone, and an overhead camera distinct from said robot camera; and,

a remote station that is coupled to said robot face and said overhead camera, said remote station includes a station monitor, a station camera, a station speaker and a station microphone, wherein at least one of said robot camera and said overhead camera can be controlled from the remote station.

2. The system of claim **1**, wherein said remote station can display a video image from either said robot camera or said overhead camera.

3. The system of claim **1**, wherein said remote station monitor simultaneously displays a video image from said robot camera and a video image from said overhead camera.

4. The system of claim **1**, wherein said remote station determines an optimal view of an object and displays a video image from said robot camera or said overhead camera, whichever provides said optimal view.

5. The system of claim **1**, wherein said robot camera automatically moves to capture a video image of a field of view that is at least substantially the same as a field of view of said overhead camera.

6. The system of claim **1**, wherein said overhead camera automatically moves to capture a video image of a field of view that is at least substantially the same as a field of view of said robot camera.

7. The system of claim **1**, wherein said cart includes an overhead microphone.

8. The system of claim **7**, wherein said remote station includes an input that allows a user to switch between said robot microphone and said overhead microphone.

9. The system of claim **7**, wherein said sound generated by said station speakers is automatically switched between said robot microphone or said overhead microphone based on a characteristic of sound captured by said robot and overhead microphones.

10. The system of claim **1**, wherein said cart includes an actuator that can vary a height of said robot face.

11. The system of claim **1**, wherein said cart includes an articulated arm that is coupled to and can move said robot face, and a boom that is coupled to said overhead camera.

12. The system of claim **11**, wherein said robot face includes an input panel and can be operated as a computer.

13. The system of claim **11**, wherein said articulated arm and said boom include position sensors.

14. The system of claim **11**, wherein further comprising a laser pointer attached to said boom.

15. The system of claim **11**, wherein said cart boom includes a detachable handle.

16. A method for remotely viewing a field of view, comprising:

moving a cart, the cart includes a robot face that has a robot monitor, a robot camera, a robot speaker, a robot microphone, and an overhead camera distinct from said robot camera;

transmitting to a remote station a video image captured by the robot camera or a video image captured by the overhead camera, the remote station includes a station monitor, a station camera, a station speaker and a station microphone; and,

controlling at least one of said robot camera and said overhead camera in response to a command received from the remote station.

17. The method of claim **16**, wherein the video images captured by the robot and overhead cameras are both transmitted to the remote station.

18. The method of claim **17**, wherein the remote station monitor simultaneously displays the video image from the robot camera and the video image from the overhead camera.

19. The method of claim **16**, wherein the remote station determines an optimal view of an object and displays a video image from robot camera or the overhead camera, whichever provides the optimal view.

20. The method of claim **16**, further comprising automatically moving the robot camera to capture a video image of a field of view that is at least substantially the same as a field of view of the overhead camera.

21. The method of claim **16**, further comprising automatically moving the overhead camera to capture a video image of a field of view that is at least substantially the same as a field of view of the robot camera.

22. The method of claim **16**, further comprising capturing sound with an overhead microphone of the cart.

23. The method of claim **22**, further comprising selecting an input to switch between the robot microphone and the overhead microphone.

24. The method of claim **22**, further comprising automatically switching between the robot microphone and the overhead microphone based on a characteristic of the sound captured by the robot and overhead microphones.

25. The method of claim **16**, further comprising varying a height of the robot face.

26. The method of claim **25**, wherein the robot face is moved in two degrees of freedom.

27. The method of claim **16**, wherein the cart is moved within an operating room.

28. The method of claim **27**, further comprising moving the overhead camera above a sterile field.

29. The method of claim **16**, further comprising entering input into the robot face.

30. The method of claim **16**, further comprising replacing a detachable handle of the cart.

* * * * *

Exhibit H

US010483007B2

(12) **United States Patent**
Celmins et al.

(10) **Patent No.: US 10,483,007 B2**
(45) **Date of Patent: Nov. 19, 2019**

(54) **MODULAR TELEHEALTH CART WITH THERMAL IMAGING AND TOUCH SCREEN USER INTERFACE**

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(73) Assignee: **INTOUCH TECHNOLOGIES, INC.**, Goleta, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/045,600**

(22) Filed: **Jul. 25, 2018**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**

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G16H 80/00	(2018.01)
H04N 5/44	(2011.01)
H04N 5/247	(2006.01)
H04N 5/225	(2006.01)
H04N 5/232	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***G16H 80/00*** (2018.01); ***H04N 5/2251*** (2013.01); ***H04N 5/2257*** (2013.01); ***H04N 5/2258*** (2013.01); ***H04N 5/23206*** (2013.01); ***H04N 5/23216*** (2013.01); ***H04N 5/23296*** (2013.01); ***H04N 5/23299*** (2018.08); ***H04N 5/232061*** (2018.08); ***H04N 5/247*** (2013.01); ***H04N 5/4403*** (2013.01); ***H04N 7/142*** (2013.01); ***H04N 7/147*** (2013.01); ***H04N 7/15*** (2013.01); *G06F 3/0482* (2013.01); *H04N 2005/443* (2013.01); *H04N 2005/4408* (2013.01)

(58) **Field of Classification Search**

CPC G16H 80/00; H04N 5/44; H04N 5/247; H04N 5/225; H04N 5/232; H04N 7/14; H04N 7/15

USPC 348/14.01–14.16; 434/262

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0052527 A1*	3/2005	Remy	.....	H04N 7/181 348/14.08
2011/0010200 A1*	1/2011	Firozvi	.....	G06F 19/3418 705/3

(Continued)

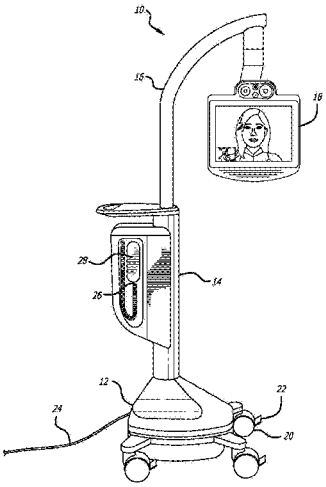
Primary Examiner — Melur Ramakrishnaiah

(74) *Attorney, Agent, or Firm* — Christopher Lambrecht

(57) **ABSTRACT**

A telemedicine system including a cart that allows for two-way audio/video conferencing between patients or local care providers and remote care providers or family members. The cart employs a modular design that allows its capabilities to be expanded to meet the needs of particular telemedicine applications. In addition, the cart provides thermal imaging and a user interface that allows local care provers to access various capabilities of the device while the device is not in session with a remote party.

20 Claims, 9 Drawing Sheets



(51) **Int. Cl.**
H04N 7/14 (2006.01)
G06F 3/0482 (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2013/0191363	A1*	7/2013	LeBeau	G06F 17/3087 707/706
2015/0032463	A1*	1/2015	Pasricha	G06Q 50/22 705/2
2015/0234998	A1*	8/2015	Slusser	A61G 13/0018 705/2
2015/0305086	A1*	10/2015	Uttley	B62B 1/12 280/652
2016/0180743	A1*	6/2016	Ahmad	G06F 19/3418 434/262
2016/0284202	A1*	9/2016	Traughber	G08B 25/016
2016/0328532	A1*	11/2016	Rieder	G06F 19/3418
2017/0095157	A1*	4/2017	Tzvieli	A61B 5/0077

* cited by examiner

FIG. 1

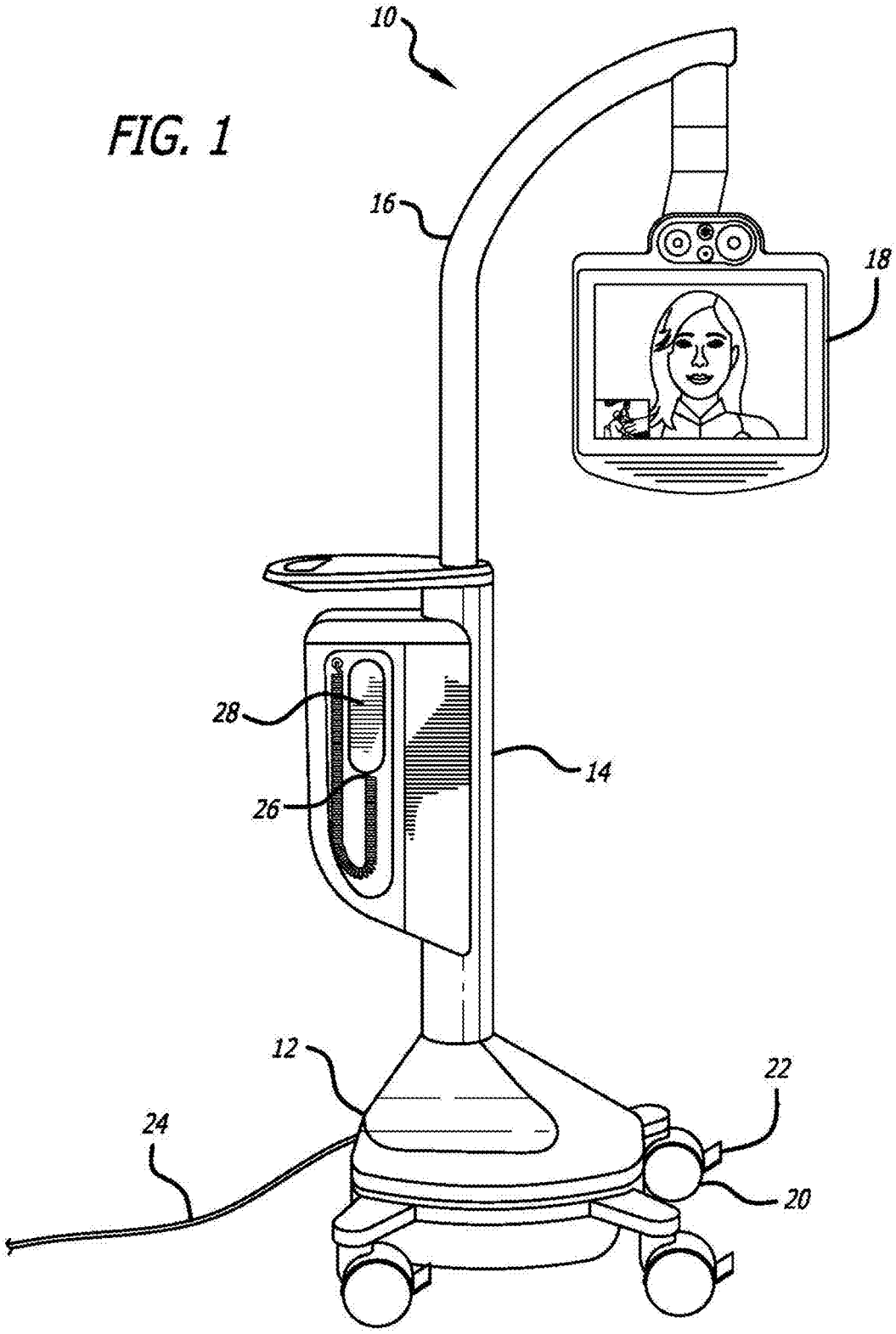


FIG. 2

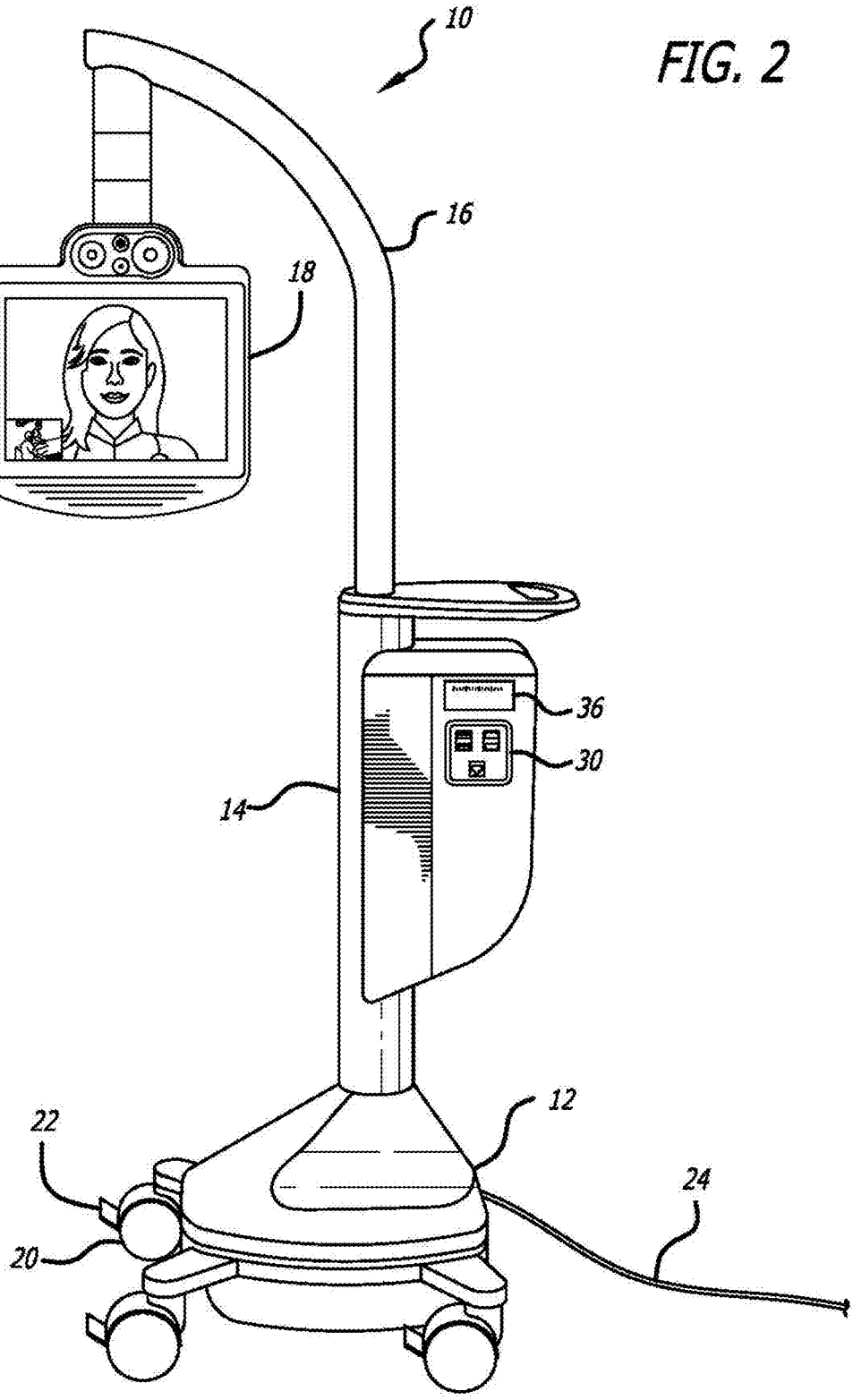


FIG. 3

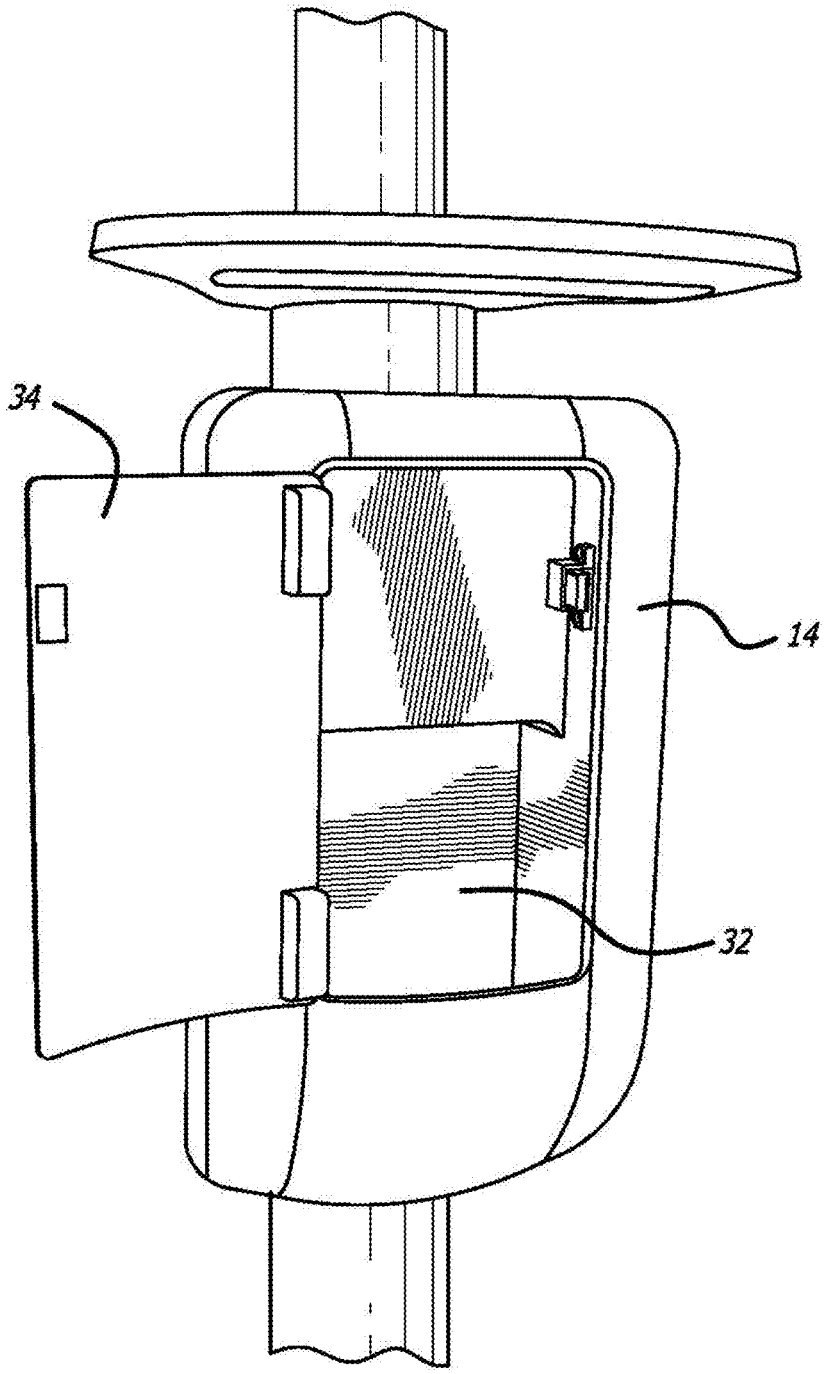


FIG. 4

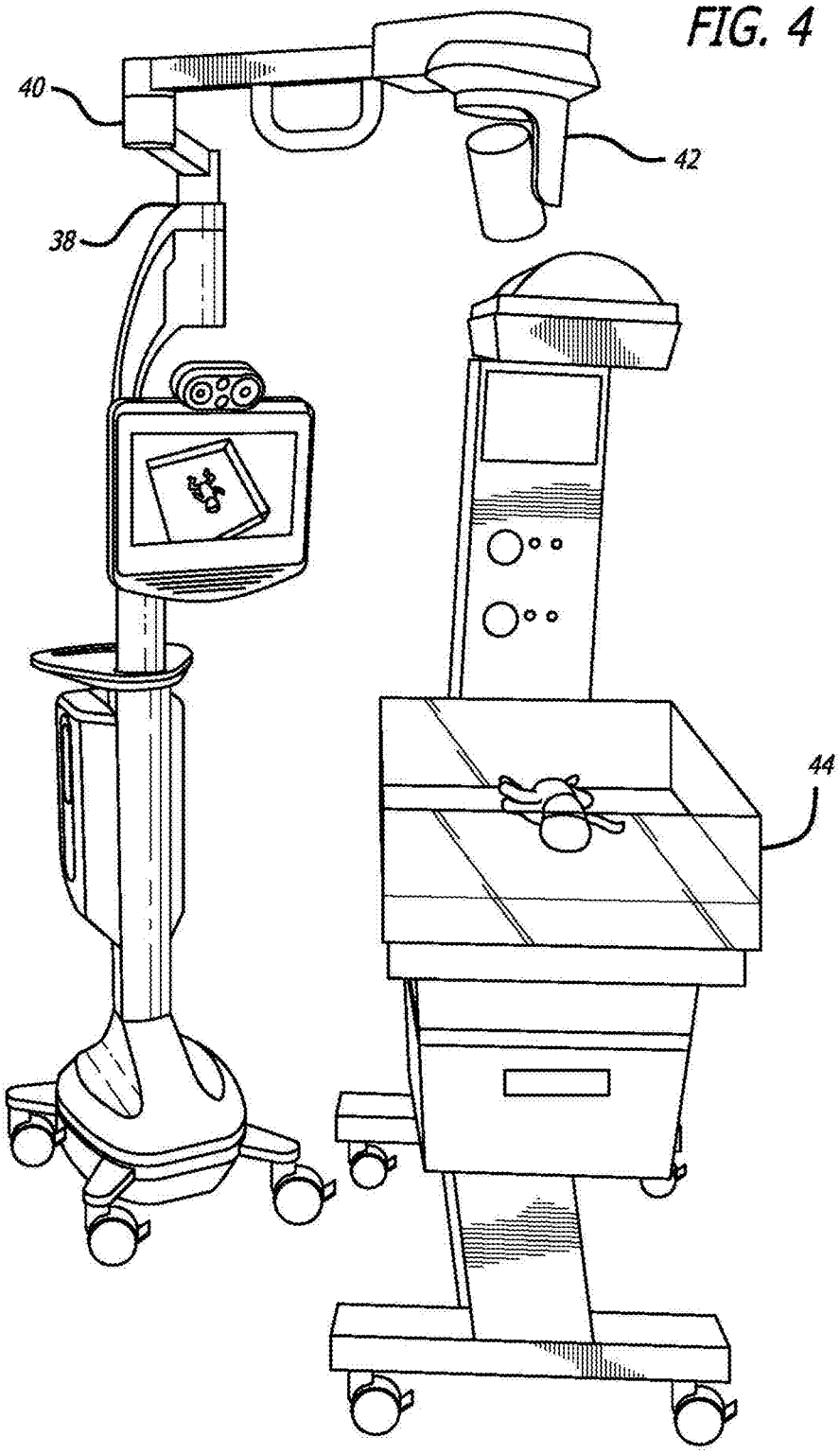


FIG. 5A

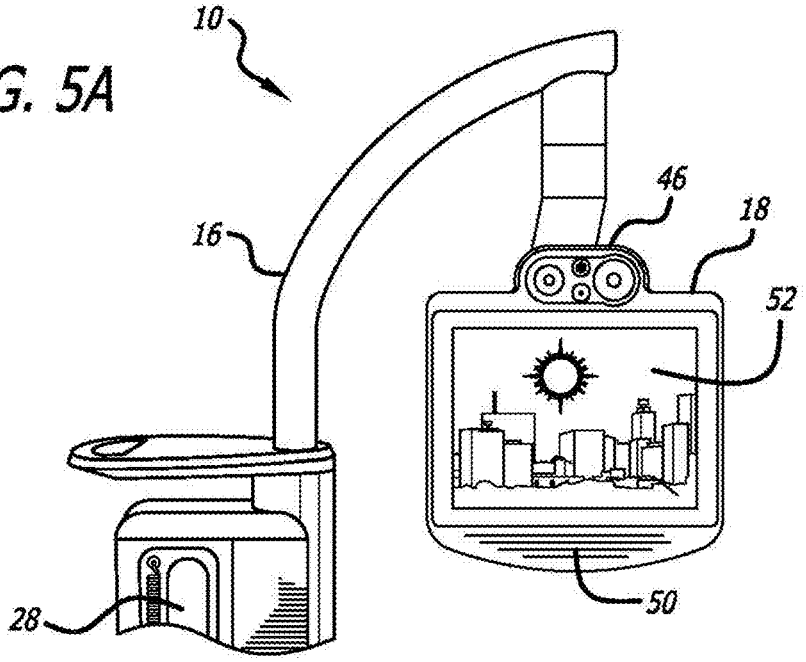


FIG. 5B

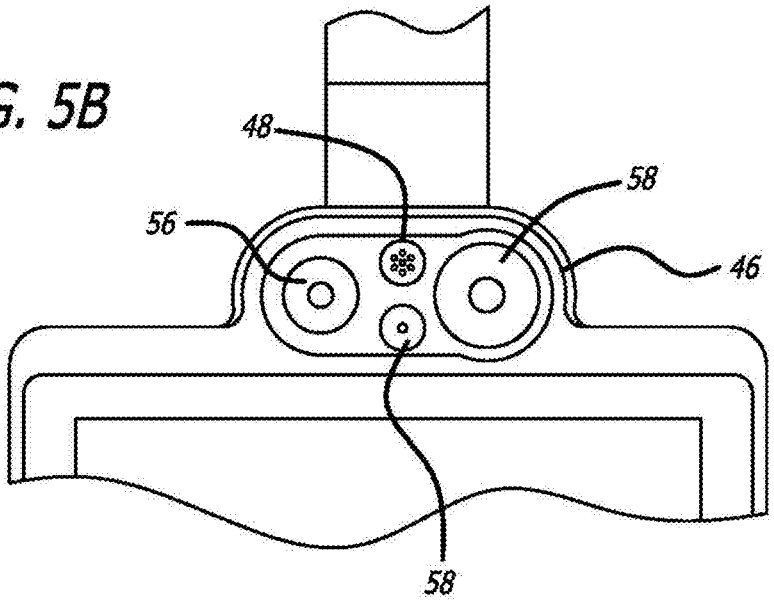


FIG. 6

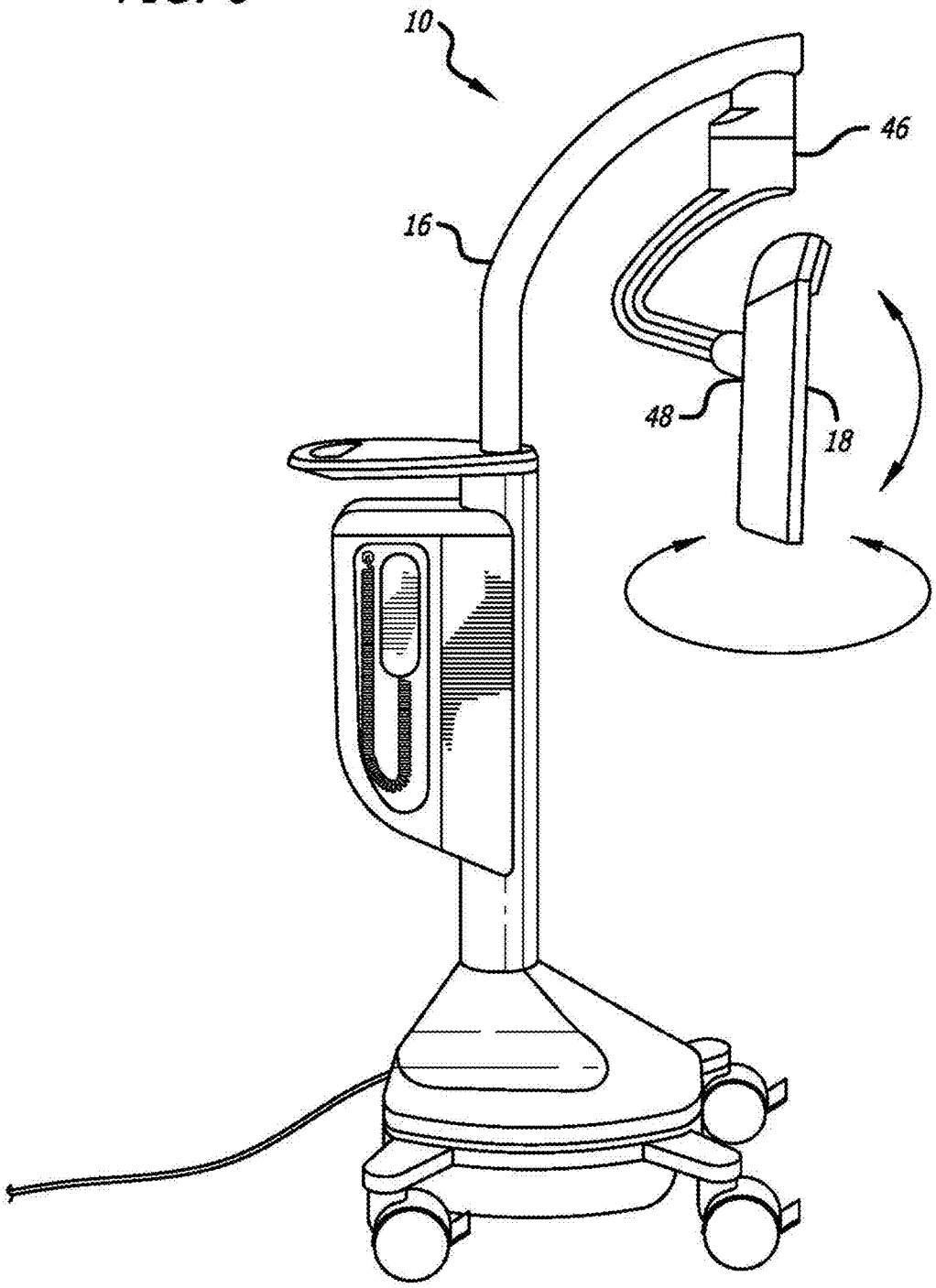


FIG. 7A

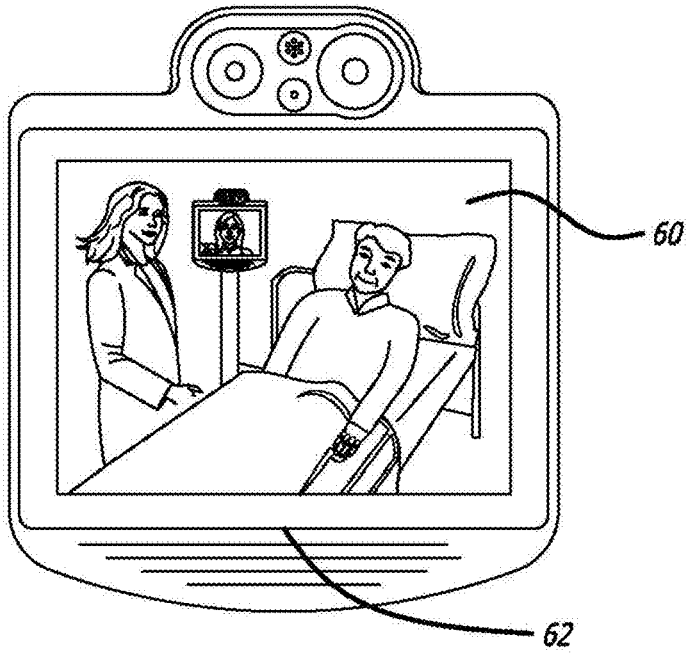

60
62

FIG. 7B

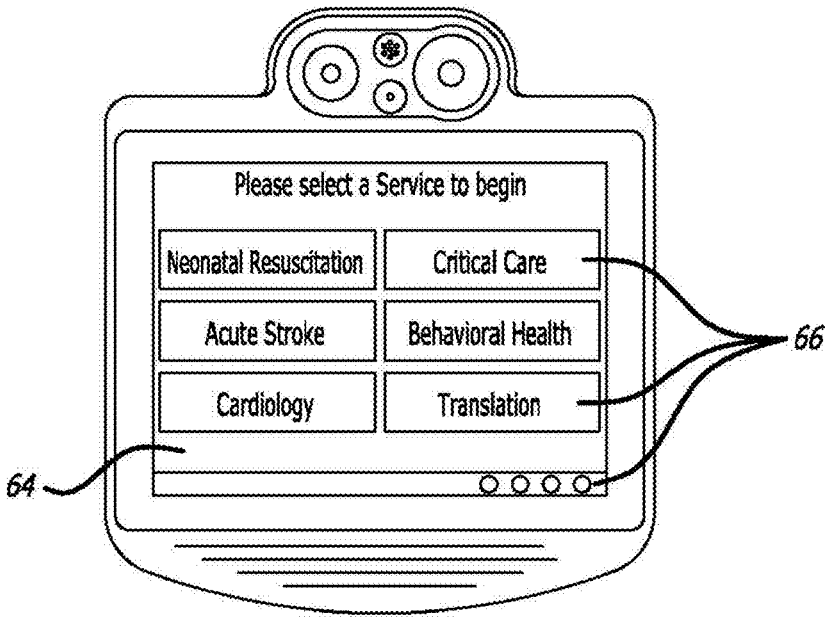

Please select a Service to begin
Neonatal Resuscitation
Critical Care
Acute Stroke
Behavioral Health
Cardiology
Translation
64
66

FIG. 7C

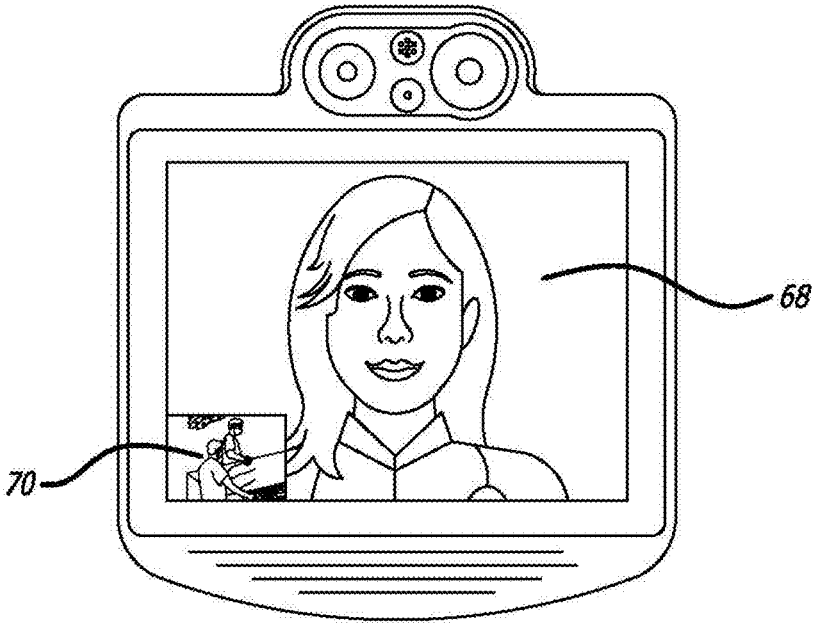
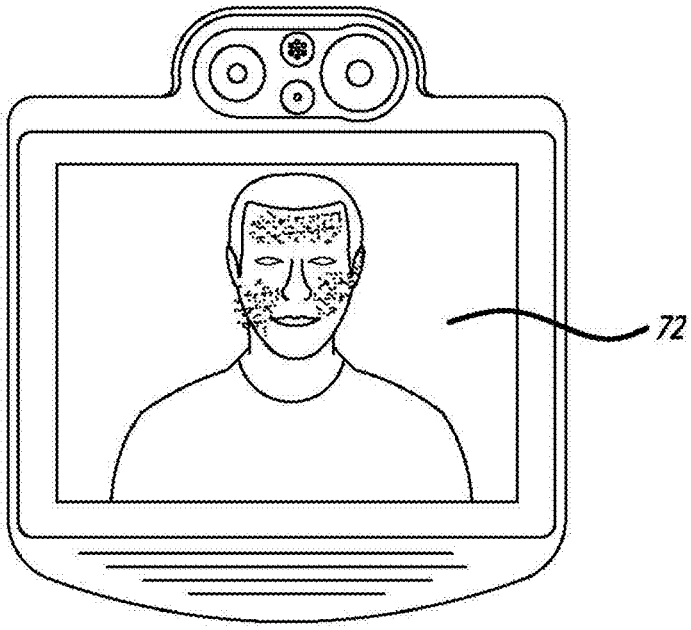


FIG. 7D



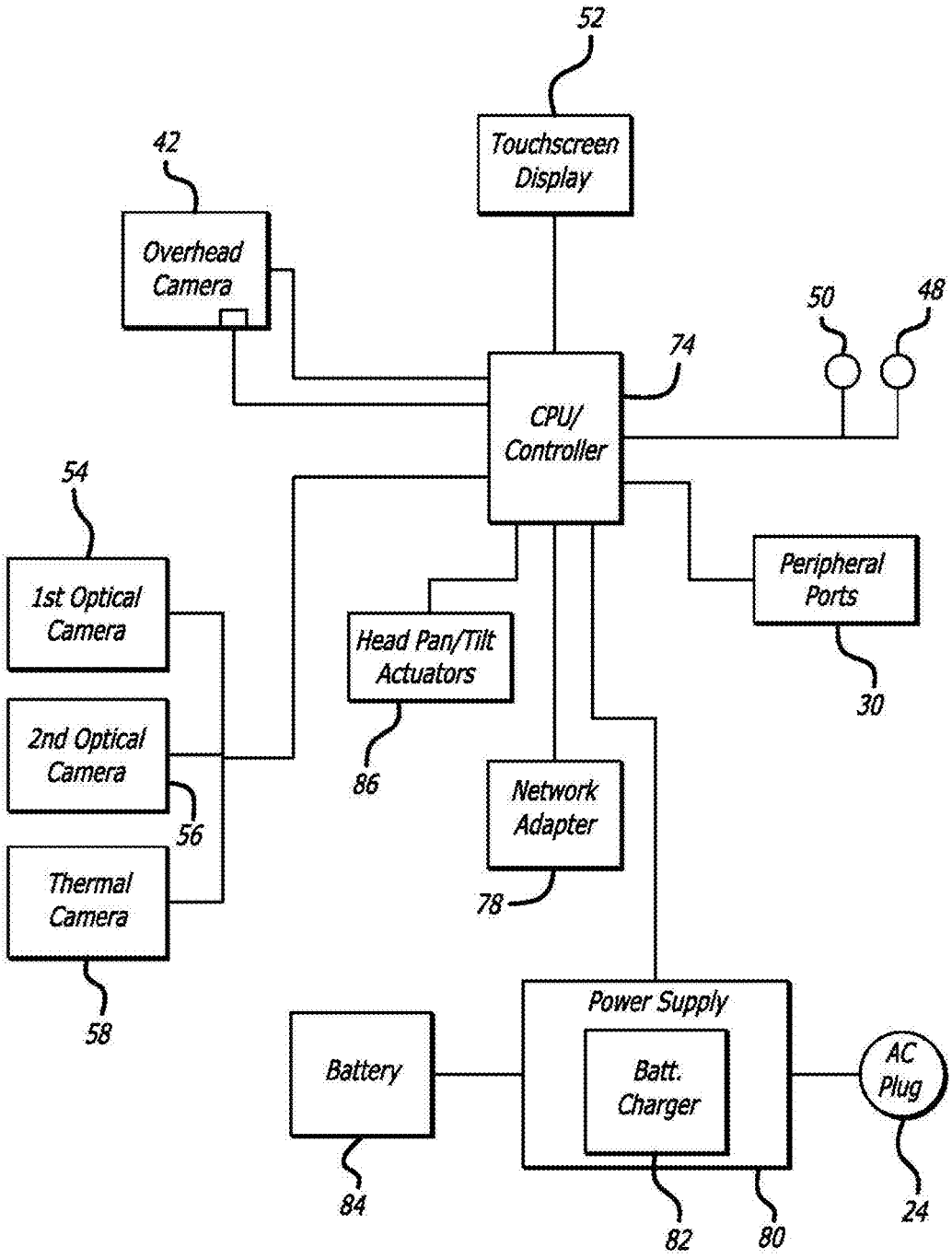

52
Touchscreen Display
42
Overhead Camera
50
48
74
CPU/ Controller
54
1st Optical Camera
Peripheral Ports
30
Head Pan/Tilt Actuators
86
2nd Optical Camera
56
Network Adapter
78
Thermal Camera
58
Power Supply
Battery
Batt. Charger
AC Plug
84
82
80
24

FIG. 8

MODULAR TELEHEALTH CART WITH THERMAL IMAGING AND TOUCH SCREEN USER INTERFACE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Application No. 62/536,907, filed Jul. 25, 2017, the contents of which are hereby incorporated by reference.

BACKGROUND

Telemedicine, also referred to as telehealth, generally refers to the use of technology to enable physicians or other healthcare providers to examine and treat or recommend treatment for a remotely located patient. Although telemedicine can be practiced using technology as simple as a telephone, the telemedicine solution market today includes devices and software having a wide range of sophistication. Examples of telemedicine devices include the INTOUCH XPRESS, INTOUCH VICI, INTOUCH VANTAGE, INTOUCH LITE, and INTOUCH VITA, all marketed by INTOUCH TECHNOLOGIES, INC., of Goleta, Calif.

The range of solutions generally intends to satisfy the functional and economic requirements of telemedicine encounters in different types of settings with varying levels of acuity. For example, smartphones, tablets, or laptop computers with basic audiovisual capabilities may be sufficient for a patient to consult with their doctor on treating a cold or behavioral health issues. These types of devices, however, may be insufficient in a higher acuity setting such as a hospital emergency department, intensive care unit, or specialty clinic, where the remote physician may require more capable video or imaging devices and/or the ability to monitor data from peripheral medical devices in real time. Other settings where telemedicine is practiced may present other unique requirements.

Thus, the telemedicine solution market is replete with disparate devices and software solutions that seek to satisfy the varied requirements of many different telehealth encounter settings. In addition, while many of these devices offer great value in terms of their ability to provide real-time audio/video consultation between remote parties, few of these devices provide any value to local care providers when not being used in a session with a remote care provider.

SUMMARY

It would be desirable to provide a telemedicine device with broader economic suitability by employing a modular design that allows the device's functionality to be expanded for applications that demand it. For example, it would be beneficial to include an integrated overhead boom camera for neonatal intensive care applications or any application involving a sterile field. Further, it would be beneficial to include an integrated peripheral expansion bay and/or thermal camera for certain care applications.

In addition, it would be desirable to provide a telemedicine device that includes features and/or services that can be utilized by local care providers even when a remote care provider is not logged in to the device. For example, it would be valuable to allow local care providers to request a remote consultation from the device itself. The request for consultation could be for a medical consultation with a remote physician, a family member consultation with a member of the patient's family, or a language translation service in situations where the patient and/or members of the care team do not speak a common language. It would also be valuable to allow local care providers to control any cameras installed on the device and monitor video from these cameras on a display of the telemedicine device when the device is not in session with a remote care provider.

To achieve these ends, one aspect of the disclosure includes a telemedicine system comprising a cart that supports a controller coupled to a camera system, a touchscreen display, a microphone, a speaker, and a network. The controller is configured to display a user interface on the touchscreen display in response to a user input received via the touchscreen display. The user interface includes at least a first selectable option that causes video captured by the camera system to be displayed on the touchscreen display and a second option to transmit a request for consultation via the network. The telemedicine system also includes a remote device coupled to the controller via the network. The remote device includes a camera, a display, a microphone, and a speaker. The remote device is configured to establish a communication session with the controller. During the communication session, the controller causes the touchscreen display to display video captured by the camera of the remote device.

BRIEF SUMMARY OF THE DRAWINGS

FIG. **1** illustrates a view of a telemedicine cart in accordance with the disclosure.

FIG. **2** illustrates a second view of a telemedicine cart in accordance with the disclosure.

FIG. **3** illustrates a rear view of a telemedicine cart in accordance with the disclosure.

FIG. **4** illustrates an example of a telemedicine cart with an overhead boom camera installed in accordance with the disclosure.

FIG. **5** illustrates a detailed view of the head of a telemedicine cart in accordance with the disclosure.

FIG. **6** illustrates another view of a telemedicine cart in accordance with the disclosure.

FIGS. **7**A-D illustrate various screens of a user interface of a telemedicine cart in accordance with the disclosure.

FIG. **8** is a block diagram of electronic components of a telemedicine cart in accordance with the disclosure.

DETAILED DESCRIPTION

The following disclosure includes a telemedicine system including a cart that allows for two-way audio/video conferencing between patients or local care providers and remote care providers or family members. The cart employs a modular design that allows its capabilities to be expanded to meet the needs of particular telemedicine applications. In addition, the cart provides a number of features to local care provers that can be accessed while the device is not in session with a remote party.

FIGS. **1**-**2** illustrate several views of an example of a telemedicine cart **10** in accordance with the disclosure. The cart **10** includes a base **12**, a trunk **14**, a neck **16**, and a head **18**. The base **12** may include casters **20** that allow the cart **10** to be wheeled around a healthcare facility. The casters **20** may include wheel locks **22** for locking the wheels and immobilizing the cart **10** in its desired location. The base **12** may house one or more batteries (not shown) that power the various electrical and electronic components of the cart. The base may also house a battery charger coupled to a power

supply that includes an AC power cord **24** that can be plugged into a wall socket to energize the power supply.

The trunk may include a receptacle **26** for a privacy handset **28** that allows a person in the vicinity of the cart **10** to communicate privately with a remote user logged into the device. As shown in FIG. **2**, the trunk **14** may also include a peripheral expansion bay **30** that includes one or more communication ports, including USB ports, HDMI ports, ETHERNET ports, etc. The trunk **14** may also include a status indicator panel **36** that displays the status of various elements of the cart. For example, the status indicator panel **36** may display current battery life or charge level and wireless network strength. As shown in FIG. **3**, the rear of the trunk may also include a storage bin **32** with a door **34** that can be shut and latched. The storage bin **32** may be used to stow medical peripherals when not use. Examples of medical peripherals include stethoscopes, otoscopes, dermal cameras, etc.

The neck **16** extends up from the trunk **14** along a track (not shown) that runs vertically up the trunk. The neck **16** may be moved up or down along the track to shrink or elongate the neck **16** and vary the height of the head **18**. The track may employ friction elements, latches, springs, and/or counter weights (not shown) to achieve smooth movement of the neck **16** along the track and ensure that the neck **16** and head **18** remain at the desired height when not being raised or lowered. The variable length of the neck **16** may allow the height of the head **18** to be varied from approximately four feet above the floor to six feet above the floor. The top of the neck **16** may include a mount point **38** adapted to receive one end of an articulating boom **40** that supports an additional, overhead pan-tilt-zoom (PTZ) camera **42**, as shown in FIG. **4**. This configuration is beneficial in, e.g., a neonatal intensive care environment in which local care providers will often surround an infant bed **44** and the overhead camera **42** is crucial for the remote care provider to view the infant. This configuration is also beneficial in any environment in which there is a sterile field that precludes moving the cart **10** within a certain distance of the patient without requiring subsequent sterilization, as is the case for many surgical procedures.

FIGS. **5**A-B show an example of the head **18** of a cart in accordance with the disclosure. The head **18** includes a camera system **46**, one or more microphones **48**, one or more speakers **50**, and a touchscreen display **52** all coupled to a controller (not shown), which may be located in the head, the base, or any other suitable location in the cart. The camera system **46** may include a first optical camera **54** having a wide field of view or viewing angle and a second optical camera **56** having a narrow field of view with a higher zoom factor than the first optical camera **54**. The controller may stream video from both optical cameras **54**, **56** over the network to the remote device for display simultaneously, or the controller may switch the video stream being sent to the remote device between the first optical camera **54** and the second optical camera **56** depending on the zoom factor or field of view requested by the user of the remote device. Further details of a multi-camera teleconferencing system are discussed in U.S. Pat. No. 9,198,728, filed Sep. 30, 2005, entitled "Multi-Camera Mobile Teleconferencing Platform", the contents of which are hereby incorporated by reference.

The camera system may also include a thermal camera **58**. An example of a suitable thermal camera is the BOSON 320 Camera Core manufactured by FLIR. The thermal camera may aid a physician or care provider in diagnosing a variety of conditions that may be invisible to the eye or optical cameras **54**, **56** but result in irregular or otherwise unusual heat patterns on the patient's body. For example, irregular heat patterns such as "hot spots" on the patient's body may be indicative of localized trauma, infection, or irritation. Other patterns such as asymmetric blood flow in the limbs or the face may be indicative of ischemic stroke or other conditions that result in irregularities in the patient's blood flow. In addition to spatial anomalies in the patient's body heat, the thermal camera **58** may allow a care provider to detect temporal irregularities in the patient's temperature by analyzing temperature trends in images from the thermal camera **58** taken over time. The system may also be configured to use computer vision techniques to analyze the images captured by the thermal camera **58** and automatically detect spatial and temporal temperature irregularities discussed above. Further details of the use of thermal imaging devices in medical and telemedicine applications can be found in U.S. patent application Ser. No. 13/111,208, filed May 19, 2011, entitled "Mobile Videoconferencing Robot System with Autonomy and Image Analysis", and U.S. application Ser. No. 14/091,292, filed Feb. 13, 2014, entitled "Enhanced Diagnostics for a Telepresence Robot", the contents of which are hereby incorporated by reference.

In addition, a user interface for the thermal camera **58** such as that discussed in U.S. Appl. No. 62/536,907, the contents of which are incorporated by reference, may be available either on the touchscreen display as well as at a remote device logged into the cart. This interface makes available certain features such as temperature and color thresholding and measuring a point-to-point temperature differential on the patient's body using cursors positioned by the user on the thermal image displayed in the interface.

Although their viewing angles and zoom factors may be different, the various cameras **54**, **56**, **58** of the camera system in the head **18** of the cart are closely positioned and similarly oriented so as to allow switching between their respective streams while maintaining a similar perspective of the environment. For example, each of the cameras may face the same direction and be positioned less than three inches apart.

As shown in FIG. **6**, the head **18** may be coupled to the neck **16** via a pan joint **46** and a tilt joint **48** that allow the head **18** to be panned and/or tilted relative to the neck **16**. The joints **46**, **48** may include motorized actuators that allow the pan and or tilt angles of the head **18** to be controlled remotely or via a control interface on the cart **10**. The panning and tilting head **18** allows the remote user to reorient the camera system **46** to look around the environment surrounding the cart **10**. The touchscreen display **52** may pan and tilt with the camera system **46** and always face the same general direction in which the camera system **46** faces. This creates the impression that the remote user is in the room and looking around the room in much the same way as a person actually in the room would. This provides an enhanced sense of the remote user's presence to people in the vicinity of the cart **10**. The pan and tilt actuators between the neck **16** and the head **18** are also designed so as to allow the pan and tilt angle of the head **18** to be manually adjusted a user in the vicinity of the cart **10** by tilting or rotating the head **18** by hand.

FIG. **7**A illustrates an example of a screen saver **60** that may be displayed as part of a user interface **62** on the touchscreen display **52** of the cart **10** when the system is idle. Touching the touchscreen **52** or otherwise interacting with the cart may cause the user interface **62** to transition the touchscreen display **52** from the screen saver **60** depicted in FIG. **7**A to the menu **64** shown in FIG. **7**B.

The menu illustrated in FIG. **7**B may include a number of selectable options **66** including requesting a consultation with a remote physician or care provider. The menu **64** may display one or more different types of consultations, which may result in the request for consultation being sent to a specific care provider. Alternatively, any request for consult may simply sent to a general care coordination center with the requested type of consultation included in the request. Personnel at the care coordination center may then forward the request to the appropriate care provider. The various consultation types illustrated in FIG. **7**B include neonatal resuscitation, critical care, acute stroke, behavioral health, and cardiologist. Those skilled in the art will recognize that many other types of consultations may be available for request.

Another selectable option **66** from the menu screen shown in **6**B is "translation." When the user selects this option, the system may transmit a request for consult to a multi-lingual translator who can then log into the cart from their remote device and translate among parties who do not speak a common language. Upon selecting the translation option, the system may present another menu of specific language translation options (e.g., "Spanish", "French", etc.) that can be chosen to identify an appropriate translator. Alternatively, selecting the language translation option may send a request for a translator to personnel who may then locate an appropriate translator. The language translation service mode may include an option to mute video from any camera on the cart for privacy reasons.

The menu in FIG. **7**B may also include a "friends and family" option that allows a user in proximity of the device to request a consultation with a member of the patient's family or friend group. When this option is selected, the touchscreen display may prompt the user for a telephone number, email address, or other communication address. The user may enter the requested information using alpha-numeric keys displayed on the touchscreen, voice recognition, external keyboard, or other means. Once the requested information has been supplied, the controller may then transmit a message, e.g., a text message or email, to the provided address. The message may include a universal resource locator or other link that can be selected to launch a specific application on the recipients device that can connect to and establish a communication session with the cart via the internet. Alternatively, the link may simply direct a web browser on the recipients device to a web portal that allows the remote user's device to connect to and establish a communication session with the cart.

Once connected, or "in session," the cart may display video received from a camera of the remote user's device on the touchscreen display. In many cases, this video **68** will include the face of the remote user, as illustrated in FIG. **7**C. In addition, video from the cart's camera system (or overhead camera) will be streamed to and displayed on a display of the remote user's device. This video may also be displayed on the touchscreen display of the cart in a picture-in-picture window **72**. The cart microphone and speaker will be coupled to the speaker and microphone of the remote user's device so that people in the vicinity of the cart and the remote user(s) can hear each other.

By interacting the with user interface of the application on the remote device, the remote user can control the pan, tilt, and zoom of the camera system to look around the cart's environment. The remote user can also select to display video from any combination of the optical camera(s), the thermal camera, and the overhead camera. The user interface on the remote device may include a multi-view function that allows the user to simultaneously stream and view video from any two or more of the cameras coupled to the cart, including any imaging devices that may be connected to the cart's expansion bay, such as an otoscope or sonogram device. By way of example, the user may train the camera system to view the patients leg with the optical camera and simultaneously display video from the thermal camera to assist in identifying an irregular heat pattern on the patient's leg. Further details of an exemplary user interface for a remote device in telemedicine system can be found in U.S. application Ser. No. 10/962,829, filed Oct. 11, 2004, entitled "Graphical interface for a remote presence system", U.S. Pat. No. 9,361,021, filed Nov. 21, 2014, entitled "Graphical User Interfaces Including Touchpad Driving for Telemedicine Devices", and U.S. Pat. No. 9,098,611, filed Mar. 14, 2013, entitled "Enhanced Video Interaction for a User Interface of a Telepresence Network", the contents of which are hereby incorporated by reference.

Another selectable option **66** available from the menu screen in FIG. **7**B may be to display video from any imaging devices connected to the cart, including the optical camera(s), thermal camera, overhead camera, or any imaging devices connected to the expansion bay. For example, FIG. **7**D illustrates an example of the touchscreen interface displaying a thermal video image **72** captured by the thermal camera on the cart. Even though the cart is not in session with a remote care provider, a local care provider may wish to view the patient's body using the thermal camera. In this case, the user may simply select, from the menu on the touchscreen display, to display the video from the thermal camera on the touchscreen display. The video from the thermal camera may then be displayed on the touchscreen and the user can adjust the height, pan, and/or tilt of the head to train the thermal camera on the desired part of the patient's body. The system may also allow the user to change the zoom factor of the displayed video using "pinch" or "spread" gestures on the touchscreen, or manipulating buttons or slider bars displayed on the touchscreen.

If the cart is configured with an the overhead boom camera, the touchscreen interface may also allow the user to display video from the overhead camera on the touchscreen interface and allow the user to adjust the pan, tilt, and zoom of the overhead camera. This is especially useful when the user is positioning the cart and adjusting the boom height in preparation for a consultation with a remote care provider who will utilize the overhead camera to view a sterile field or infant bed.

The menu displayed in FIG. **7**B may also include an option for a local care provider to open or launch a clinical protocol, workflow, or otherwise open and edit a medical form or record using the touchscreen interface. For example, when a patient arrives for a telehealth consultation with a remote physician, a nurse or medical assistant may open a medical record for the patient using the touchscreen interface and begin documenting the encounter, including entering the patient's current vital signs into the record before the remote physician is notified that the patient is ready to begin the consultation. In another embodiment, if a patient arrives in an emergency department showing signs of a stroke, a nurse or doctor may launch a stroke consult form or workflow using the touchscreen interface and begin documenting the encounter and proceeding through the various steps prescribed in the medical facility's stroke protocol. Further details regarding editing patient records and documenting clinical encounters during a telemedicine encounter can be found in U.S. patent application Ser. No. 10/936,041, filed Sep. 7, 2004, entitled "Tele-presence system that allows for

remote monitoring/observation and review of a patient and their medical records", U.S. Pat. No. 8,179,418, filed Apr. 14, 2008, entitled "A Robotic Based Health Care System", U.S. Pat. No. 8,849,680, filed Jan. 29, 2009, entitled "Documentation Through A Remote Presence Robot", and U.S. application Ser. No. 15/965,623, filed Apr. 27, 2018, entitled "Telehealth Cart that Supports a Removable Tablet with Seamless Audio/Video Switching", the contents of which are hereby incorporated by reference.

FIG. **8** illustrates a block diagram of the various electrical components of a telemedicine cart in accordance with the disclosure. The cart includes a CPU or controller that may take the form of a computer running Microsoft Windows, LINUX, UNIX, MAC OS, or other similar operating system. The cart may include first and second optical cameras **54**, **56** as well as a thermal camera **58** and an overhead camera **42**. The overhead camera may be a PTZ camera and have a separate control interface **76**, such as an RS-232 interface, that provides enhanced control of the actuators that control the pan, tilt, and zoom of the overhead camera **42**. The cart may also include a touchscreen display **52** coupled to the controller **74** that can display images, including video and the user interface described above, as well as receive touch input from the user to provide to the controller. The cart may also include at least one speaker **50** and at least one microphone **48** coupled to the controller **74**. The controller **74** is coupled to at least one network adapter **78** to allow the controller **74** to communicate with other devices over a network, such as the Internet. The one or more network adapters **78** may include wired network adapters (such as Ethernet) and wireless network adapters such as WIFI and Bluetooth. The cart may also include a peripheral port expansion bay **30** coupled to the controller **74**. The peripheral ports may include HDMI, Ethernet, USB, and other interfaces for connecting to external medical devices, imaging devices, audio devices, input devices, and the like. The cart also includes an AC plug **24** coupled to a power supply **80** that powers the various electrical components of the cart. The power supply **80** may include a battery charger **82** coupled to a battery **84** to power the cart when the AC plug **24** is not plugged into an AC power source. Some components, such as the optical and thermal cameras, the touchscreen display, the microphone, and the speaker may be mounted together in the head of the cart which may have pan and tilt control provided by head pan/tilt actuators **86**, which are coupled to and controlled by the controller **74**.

Additionally, as will be appreciated by one of ordinary skill in the art, principles of the present disclosure may be reflected in a computer program product on a computer-readable storage medium having computer-readable program code embodied in the storage medium, the computer-readable program code executable by a processor. Any tangible, non-transitory computer-readable storage medium may be utilized, including magnetic storage devices (hard disks, floppy disks, and the like), optical storage devices (CD-ROMs, DVDs, Blu-Ray discs, and the like), flash memory, and/or the like. These computer program instructions may be loaded onto a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions that execute on the computer or other programmable data processing apparatus create means for implementing the functions specified. These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture, including implementing means that implement the function specified. The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer-implemented process, such that the instructions that execute on the computer or other programmable apparatus provide steps for implementing the functions specified.

The foregoing specification has been described with reference to various embodiments. However, one of ordinary skill in the art will appreciate that various modifications and changes can be made without departing from the scope of the present disclosure. Accordingly, this disclosure is to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope thereof. Likewise, benefits, other advantages, and solutions to problems have been described above with regard to various embodiments. However, benefits, advantages, solutions to problems, and any element(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, a required, or an essential feature or element. As used herein, the terms "comprises," "comprising," and any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, a method, an article, or an apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, system, article, or apparatus. Also, as used herein, the terms "coupled," "coupling," and any other variation thereof are intended to cover a physical connection, an electrical connection, a magnetic connection, an optical connection, a communicative connection, a functional connection, and/or any other connection.

While the principles of this disclosure have been shown in various embodiments, many modifications of structure, arrangements, proportions, elements, materials, and components, which are particularly adapted for a specific environment and operating requirements, may be used without departing from the principles and scope of this disclosure. These and other changes or modifications are intended to be included within the scope of the present disclosure.

What is claimed is:

1. A telemedicine system comprising:

a cart that supports a controller coupled to a camera system, a touchscreen display, a microphone, a speaker, and a network, the controller is configured to display a user interface on the touchscreen display in response to a user input received via the touchscreen display, the user interface including at least a first selectable option that causes video captured by the camera system to be displayed on the touchscreen display and a second option to transmit a request for consultation via the network; and

a remote device coupled to the controller via the network, the remote device including a camera, a display, a microphone, and a speaker and configured to establish a communication session with the controller, wherein the first selectable option causes video captured by the camera system to be displayed on the touchscreen when the system is not in session and, during the communication session, the controller causes the touchscreen display to display video captured by the camera of the remote device.

2. The system of claim **1**, wherein the camera system includes a thermal camera.

3. The system of claim 2, wherein the camera system includes a first optical camera with a first field of view.

4. The system of claim 3, wherein the camera system includes a second optical camera with a second field of view.

5. The system of claim 4, wherein the cart further comprises an articulating boom that supports a third optical camera coupled to the controller, the third optical camera having a third field of view.

6. The system of claim 5, wherein the third optical camera is a pan-tilt-zoom camera.

7. The system of claim 6, wherein the controller changes at least one of the pan, tilt, and zoom of the third optical camera in response to a user input provided via the touchscreen display.

8. The system of claim 6, wherein the controller changes at least one of the pan, tilt, and zoom of the third optical camera in response to a user input received from the remote station.

9. The system of claim 1, wherein the camera system and the touchscreen display can be panned and tilted relative to the cart.

10. The system of claim 9, wherein the camera system and the touchscreen display are mechanically coupled such that they face in substantially the same direction and move together.

11. The system of claim 9, wherein the cart includes actuators configured to pan and tilt the camera system and the touchscreen display in response to commands received from the remote station.

12. The system of claim 11, wherein the actuators are configured to be manually repositioned by a person in the vicinity of the cart.

13. The system of claim 1, wherein the user interface displays a plurality of selectable consultation types that can be selected to request a consultation.

14. The system of claim 13, wherein selecting a first consultation type cause a consultation request to be transmitted to a first care provider and selecting a second consultation type causes a consultation request to be transmitted to a second care provider.

15. The system of claim 1, wherein the user interface includes a selectable option that causes the controller to display a medical form that can be completed via the touchscreen interface.

16. The system of claim 1, wherein the controller causes the user interface to display a prompt for a telephone number and subsequently transmits the consultation request to a telephone number provided by the user via the touchscreen interface in response to the prompt.

17. The system of claim 1, wherein the consultation request is transmitted via a Short Message Service protocol and includes a uniform resource locator.

18. The system of claim 17, wherein the recipient of the consultation request can select the uniform resource locator to activate an application that establishes the communication session with the controller.

19. The system of claim 1, wherein the user interface includes a selectable option for a language translation service.

20. The system of claim 1, wherein the cart includes a removable peripheral bay that includes a plurality of communication ports coupled to the controller.

* * * * *

Exhibit I

US010059000B2

(12) **United States Patent**
Herzog et al.

(10) **Patent No.: US 10,059,000 B2**
(45) **Date of Patent: *Aug. 28, 2018**

(54) **SERVER CONNECTIVITY CONTROL FOR A TELE-PRESENCE ROBOT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2 days.

This patent is subject to a terminal disclaimer.

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(56) **References Cited**

U.S. PATENT DOCUMENTS

3,821,995 A 7/1974 Aghnides
4,107,689 A 8/1978 Jellinek
(Continued)

FOREIGN PATENT DOCUMENTS

AU 1216200 A 5/2000
CA 2289697 A1 11/1998
(Continued)

OTHER PUBLICATIONS

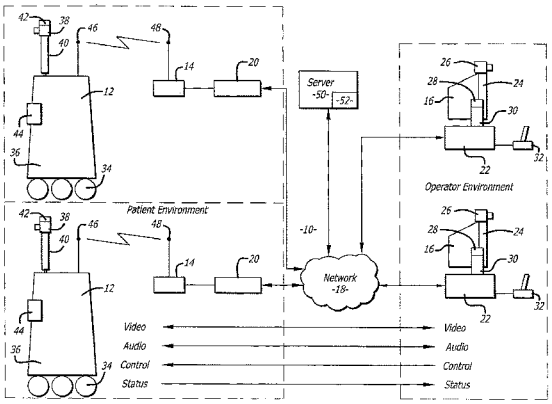
Paulos et al., "Social Tele-Embodiment: Understanding Presence", Autonomous Robots, vol. 11, Issue 1, Kluwer Academic Publishers, Jul. 2001, pp. 87-95.
(Continued)

Primary Examiner — Mary D Cheung

(57) **ABSTRACT**

A robot system with a robot that has a camera and a remote control station that can connect to the robot. The connection can include a plurality of privileges. The system further includes a server that controls which privileges are provided to the remote control station. The privileges may include the ability to control the robot, joint in a multi-cast session and the reception of audio/video from the robot. The privileges can be established and edited through a manager control station. The server may contain a database that defines groups of remote control station that can be connected to groups of robots. The database can be edited to vary the stations and robots within a group. The system may also allow for connectivity between a remote control station at a user programmable time window.

19 Claims, 7 Drawing Sheets



Related U.S. Application Data

division of application No. 12/349,288, filed on Jan. 6, 2009, now Pat. No. 8,463,435, which is a continuation-in-part of application No. 12/277,922, filed on Nov. 25, 2008, now Pat. No. 9,138,891.

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,213,182	A		7/1980	Eichelberger et al.
4,413,693	A		11/1983	Derby
4,471,354	A		9/1984	Smith
4,519,466	A		5/1985	Shiraishi
4,553,309	A		11/1985	Hess et al.
4,572,594	A		2/1986	Schwartz
4,625,274	A		11/1986	Schroeder
4,638,445	A		1/1987	Mattaboni
4,652,204	A		3/1987	Arnett
4,669,168	A		6/1987	Tamura et al.
4,679,152	A		7/1987	Perdue
4,697,278	A		9/1987	Fleischer
4,697,472	A		10/1987	Hiyane
4,709,265	A		11/1987	Silverman et al.
4,733,737	A		3/1988	Falamak
4,751,658	A		6/1988	Kadonoff et al.
4,766,581	A		8/1988	Korn et al.
4,777,416	A		10/1988	George et al.
4,797,557	A		1/1989	Ohman
4,803,625	A		2/1989	Fu et al.
4,847,764	A		7/1989	Halvorson
4,875,172	A		10/1989	Kanayama
4,878,501	A		11/1989	Shue
4,942,512	A		7/1990	Kohno
4,942,538	A		7/1990	Yuan et al.
4,953,159	A		8/1990	Hayden et al.
4,974,607	A		12/1990	Miwa
4,977,971	A		12/1990	Crane et al.
5,006,988	A		4/1991	Borenstein et al.
5,040,116	A		8/1991	Evans et al.
5,051,906	A		9/1991	Evans et al.
5,073,749	A		12/1991	Kanayama
5,084,828	A		1/1992	Kaufman et al.
5,130,794	A		7/1992	Ritchey
5,148,591	A		9/1992	Pryor
5,153,833	A		10/1992	Gordon et al.
5,155,684	A		10/1992	Burke et al.
5,157,491	A		10/1992	Kassatly
5,182,641	A		1/1993	Diner et al.
5,186,270	A		2/1993	West
5,193,143	A		3/1993	Kaemmerer et al.
5,217,453	A		6/1993	Wilk
5,220,263	A		6/1993	Onishi et al.
5,224,157	A		6/1993	Yamada et al.
5,230,023	A		7/1993	Nakano
5,231,693	A		7/1993	Backes et al.
5,236,432	A		8/1993	Matsen et al.
5,262,944	A		11/1993	Weisner et al.
5,305,427	A		4/1994	Nagata
5,315,287	A		5/1994	Sol
5,319,611	A		6/1994	Korba
5,341,242	A		8/1994	Gilboa et al.
5,341,459	A		8/1994	Backes
5,341,854	A		8/1994	Zezulka et al.
5,347,306	A		9/1994	Nitta
5,347,457	A		9/1994	Tanaka et al.
5,350,033	A		9/1994	Kraft
5,366,896	A		11/1994	Margrey et al.
5,374,879	A		12/1994	Pin et al.
5,375,195	A		12/1994	Johnston
5,400,068	A		3/1995	Ishida et al.
5,417,210	A		5/1995	Funda et al.
5,419,008	A		5/1995	West
5,436,542	A		7/1995	Petelin et al.
5,441,042	A		8/1995	Putman
5,441,047	A		8/1995	David et al.
5,442,728	A		8/1995	Kaufman et al.
5,462,051	A		10/1995	Oka et al.
5,486,853	A		1/1996	Baxter et al.
5,510,832	A		4/1996	Garcia
5,511,147	A		4/1996	Abdel-Malek
5,528,289	A		6/1996	Cortjens et al.
5,539,741	A		7/1996	Barraclough et al.
5,544,649	A		8/1996	David et al.
5,550,577	A		8/1996	Verbiest et al.
5,553,609	A	*	9/1996	Chen G06F 19/322 128/904
5,563,998	A		10/1996	Yaksich et al.
5,572,229	A		11/1996	Fisher
5,572,999	A		11/1996	Funda et al.
5,594,859	A		1/1997	Palmer et al.
5,600,573	A		2/1997	Hendricks et al.
5,617,539	A		4/1997	Ludwig et al.
5,619,341	A		4/1997	Auyeung et al.
5,623,679	A		4/1997	Rivette et al.
5,630,566	A		5/1997	Case
5,636,218	A		6/1997	Ishikawa et al.
5,652,849	A		7/1997	Conway et al.
5,657,246	A		8/1997	Hogan et al.
5,659,779	A		8/1997	Laird et al.
5,673,082	A		9/1997	Wells et al.
5,675,229	A		10/1997	Thorne
5,682,199	A		10/1997	Lankford
5,684,695	A		11/1997	Bauer
5,701,904	A		12/1997	Simmons et al.
5,734,805	A		3/1998	Isensee et al.
5,739,657	A		4/1998	Takayama et al.
5,748,629	A		5/1998	Caldara et al.
5,749,058	A		5/1998	Hashimoto
5,749,362	A		5/1998	Funda et al.
5,754,631	A		5/1998	Cave
5,758,079	A		5/1998	Ludwig et al.
5,762,458	A		6/1998	Wang et al.
5,764,731	A		6/1998	Yablon
5,767,897	A		6/1998	Howell
5,786,846	A		7/1998	Hiroaki
5,787,545	A		8/1998	Colens
5,793,365	A		8/1998	Tang et al.
5,801,755	A		9/1998	Echerer
5,802,494	A		9/1998	Kuno
5,836,872	A		11/1998	Kenet et al.
5,838,575	A		11/1998	Lion
5,844,599	A		12/1998	Hildin
5,857,534	A		1/1999	Devault et al.
5,867,494	A		2/1999	Krishnaswamy et al.
5,867,653	A		2/1999	Aras et al.
5,871,451	A		2/1999	Unger et al.
5,872,922	A		2/1999	Hogan et al.
5,876,325	A		3/1999	Mizuno et al.
5,911,036	A		6/1999	Wright et al.
5,917,958	A		6/1999	Nunally et al.
5,927,423	A		7/1999	Wada et al.
5,949,758	A		9/1999	Kober
5,954,692	A		9/1999	Smith et al.
5,959,423	A		9/1999	Nakanishi et al.
5,961,446	A		10/1999	Beller et al.
5,966,130	A		10/1999	Benman

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,973,724 A 10/1999 Riddle
5,974,446 A 10/1999 Sonnenreich et al.
5,983,263 A 11/1999 Rothrock et al.
5,995,119 A 11/1999 Cosatto et al.
5,995,884 A 11/1999 Allen et al.
5,999,977 A 12/1999 Riddle
6,006,946 A 12/1999 Williams et al.
6,031,845 A 2/2000 Walding
6,036,812 A 3/2000 Williams et al.
6,047,259 A 4/2000 Campbell et al.
6,091,219 A 7/2000 Maruo et al.
6,113,343 A 9/2000 Goldenberg et al.
6,133,944 A 10/2000 Braun et al.
6,135,228 A 10/2000 Asada et al.
6,148,100 A 11/2000 Anderson et al.
6,160,582 A 12/2000 Hill
6,170,929 B1 1/2001 Wilson et al.
6,175,779 B1 1/2001 Barrett
6,189,034 B1 2/2001 Riddle
6,201,984 B1 3/2001 Funda et al.
6,211,903 B1 4/2001 Bullister
6,219,587 B1 4/2001 Ahlin et al.
6,232,735 B1 5/2001 Baba et al.
6,233,504 B1 5/2001 Das et al.
6,233,735 B1 5/2001 Ebihara
6,250,928 B1 6/2001 Poggio et al.
6,256,556 B1 7/2001 Zenke
6,259,806 B1 7/2001 Green
6,259,956 B1 7/2001 Myers et al.
6,266,162 B1 7/2001 Okamura et al.
6,266,577 B1 7/2001 Popp et al.
6,289,263 B1 9/2001 Mukherjee
6,292,713 B1 9/2001 Jouppi et al.
6,292,714 B1 9/2001 Okabayashi
6,304,050 B1 10/2001 Skaar et al.
6,314,631 B1 11/2001 Pryor
6,317,652 B1 11/2001 Osada
6,317,953 B1 11/2001 Pryor
6,321,137 B1 11/2001 De Smet
6,324,184 B1 11/2001 Hou et al.
6,324,443 B1 11/2001 Kurakake et al.
6,325,756 B1 12/2001 Webb et al.
6,327,516 B1 12/2001 Zenke
6,330,486 B1 12/2001 Padula
6,330,493 B1 12/2001 Takahashi et al.
6,346,950 B1 2/2002 Jouppi
6,346,962 B1 2/2002 Goodridge
6,369,847 B1 4/2002 James et al.
6,373,855 B1 4/2002 Downing et al.
6,381,515 B1 4/2002 Inoue et al.
6,389,329 B1 5/2002 Colens
6,400,378 B1 6/2002 Snook
6,408,230 B2 6/2002 Wada
6,411,055 B1 6/2002 Fujita et al.
6,430,471 B1 8/2002 Kintou et al.
6,430,475 B2 8/2002 Okamoto et al.
6,438,457 B1 8/2002 Yokoo et al.
6,445,964 B1 9/2002 White et al.
6,449,762 B1 9/2002 Mcelvain
6,452,915 B1 9/2002 Jorgensen
6,457,043 B1 9/2002 Kwak et al.
6,459,955 B1 10/2002 Bartsch et al.
6,463,352 B1 10/2002 Tadokoro et al.
6,463,361 B1 10/2002 Wang et al.
6,466,844 B1 10/2002 Ikeda et al.
6,468,265 B1 10/2002 Evans et al.
6,470,235 B2 10/2002 Kasuga et al.
6,474,434 B1 11/2002 Bech
6,480,762 B1 11/2002 Uchikubo et al.
6,491,701 B2 12/2002 Tierney et al.
6,496,099 B2 12/2002 Wang et al.
6,496,755 B2 12/2002 Wallach et al.
6,501,740 B1 12/2002 Sun et al.
6,507,773 B2 1/2003 Parker et al.
6,522,906 B1 2/2003 Salisbury et al.
6,523,629 B1 2/2003 Buttz et al.
6,526,332 B2 2/2003 Sakamoto et al.
6,529,620 B2 3/2003 Thompson
6,529,765 B1 3/2003 Franck et al.
6,529,802 B1 3/2003 Kawakita et al.
6,532,404 B2 3/2003 Colens
6,535,182 B2 3/2003 Stanton
6,535,793 B2 3/2003 Allard
6,540,039 B1 4/2003 Yu et al.
6,543,899 B2 4/2003 Covannon et al.
6,549,215 B2 4/2003 Jouppi
6,563,533 B1 5/2003 Colby
6,567,038 B1 5/2003 Granot et al.
6,580,246 B2 6/2003 Jacobs
6,581,798 B2 6/2003 Liff et al.
6,584,376 B1 6/2003 Van Kommer
6,587,750 B2 7/2003 Gerbi et al.
6,590,604 B1 7/2003 Tucker et al.
6,594,269 B1 7/2003 Polcyn
6,594,552 B1 7/2003 Nowlin et al.
6,597,392 B1 7/2003 Jenkins et al.
6,602,469 B1 8/2003 Maus et al.
6,604,019 B2 8/2003 Ahlin et al.
6,604,021 B2 8/2003 Imai et al.
6,611,120 B2 8/2003 Song et al.
6,643,496 B1 11/2003 Shimoyama et al.
6,646,677 B2 11/2003 Noro et al.
6,650,748 B1 11/2003 Edwards et al.
6,666,374 B1 12/2003 Green et al.
6,667,592 B2 12/2003 Jacobs et al.
6,674,259 B1 1/2004 Norman et al.
6,684,129 B2 1/2004 Salisbury et al.
6,691,000 B2 2/2004 Nagai et al.
6,693,585 B1 2/2004 Macleod
6,710,797 B1 3/2004 Mcnelley et al.
6,724,823 B2 4/2004 Rovati et al.
6,728,599 B2 4/2004 Wang et al.
6,763,282 B2 7/2004 Glenn et al.
6,764,373 B1 7/2004 Osawa et al.
6,769,771 B2 8/2004 Trumbull
6,781,606 B2 8/2004 Jouppi
6,784,916 B2 8/2004 Smith
6,785,589 B2 8/2004 Eggenberger et al.
6,791,550 B2 9/2004 Goldhor et al.
6,798,753 B1 9/2004 Doganata et al.
6,799,065 B1 9/2004 Niemeyer
6,799,088 B2 9/2004 Wang et al.
6,804,580 B1 10/2004 Stoddard et al.
6,804,656 B1 10/2004 Rosenfeld et al.
6,810,411 B1 10/2004 Coughlin et al.
6,816,192 B1 11/2004 Nishikawa
6,816,754 B2 11/2004 Mukai et al.
6,836,703 B2 12/2004 Wang et al.
6,839,612 B2 1/2005 Sanchez et al.
6,840,904 B2 1/2005 Goldberg
6,845,297 B2 1/2005 Allard
6,852,107 B2 2/2005 Wang et al.
6,853,878 B2 2/2005 Hirayama et al.
6,853,880 B2 2/2005 Sakagami et al.
6,871,117 B2 3/2005 Wang et al.
6,879,879 B2 4/2005 Jouppi et al.
6,888,333 B2 5/2005 Laby
6,892,112 B2 5/2005 Wang et al.
6,893,267 B1 5/2005 Yueh
6,895,305 B2 5/2005 Lathan et al.
6,898,484 B2 5/2005 Lemelson et al.
6,914,622 B1 7/2005 Smith et al.
6,925,357 B2 8/2005 Wang et al.
6,951,535 B2 10/2005 Ghodoussi et al.
6,952,470 B1 10/2005 Tioe et al.
6,957,712 B2 10/2005 Song et al.
6,958,706 B2 10/2005 Chaco et al.
6,965,394 B2 11/2005 Gutta et al.
6,990,112 B1 1/2006 Brent et al.
6,995,664 B1 2/2006 Darling
7,007,235 B1 2/2006 Hussein et al.
7,011,538 B2 3/2006 Chang
7,015,934 B2 3/2006 Toyama et al.
RE39,080 E 4/2006 Johnston

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,030,757 B2 4/2006 Matsuhira et al.
7,053,578 B2 5/2006 Diehl et al.
7,055,210 B2 6/2006 Keppler et al.
7,058,689 B2 6/2006 Parker et al.
7,092,001 B2 8/2006 Schulz
7,096,090 B1 8/2006 Zweig
7,115,102 B2 10/2006 Abbruscato
7,117,067 B2 10/2006 Mclurkin et al.
7,123,285 B2 10/2006 Smith et al.
7,123,974 B1 10/2006 Hamilton
7,123,991 B2 10/2006 Graf et al.
7,127,325 B2 10/2006 Nagata et al.
7,129,970 B2 10/2006 James et al.
7,133,062 B2 11/2006 Castles et al.
7,142,945 B2 11/2006 Wang et al.
7,142,947 B2 11/2006 Wang et al.
7,151,982 B2 12/2006 Liff et al.
7,154,526 B2 12/2006 Foote et al.
7,155,306 B2 12/2006 Haitin et al.
7,156,809 B2 1/2007 Quy
7,158,859 B2 1/2007 Wang et al.
7,158,860 B2 1/2007 Wang et al.
7,158,861 B2 1/2007 Wang et al.
7,161,322 B2 1/2007 Wang et al.
7,162,338 B2 1/2007 Goncalves et al.
7,164,969 B2 1/2007 Wang et al.
7,164,970 B2 1/2007 Wang et al.
7,167,448 B2 1/2007 Wookey et al.
7,171,286 B2 1/2007 Wang et al.
7,174,238 B1 2/2007 Zweig
7,181,455 B2 2/2007 Wookey et al.
7,184,559 B2 2/2007 Jouppi
7,188,000 B2 3/2007 Chiappetta et al.
7,199,790 B2 4/2007 Rosenberg et al.
7,202,851 B2 4/2007 Cunningham et al.
7,206,627 B2 4/2007 Abovitz et al.
7,215,786 B2 5/2007 Nakadai et al.
7,219,364 B2 5/2007 Bolle et al.
7,222,000 B2 5/2007 Wang et al.
7,227,334 B2 6/2007 Yang et al.
7,256,708 B2 8/2007 Rosenfeld et al.
7,262,573 B2 8/2007 Wang et al.
7,283,153 B2 10/2007 Provost et al.
7,289,883 B2 10/2007 Wang et al.
7,292,257 B2 11/2007 Kang et al.
7,292,912 B2 11/2007 Wang et al.
7,305,114 B2 12/2007 Wolff et al.
7,317,685 B1 1/2008 Flott et al.
7,321,807 B2 1/2008 Laski
7,332,890 B2 2/2008 Cohen et al.
7,333,642 B2 2/2008 Green
7,346,429 B2 3/2008 Goldenberg et al.
7,352,153 B2 4/2008 Yan
7,363,121 B1 4/2008 Chen et al.
7,382,399 B1 6/2008 Mccall et al.
7,386,730 B2 6/2008 Uchikubo
7,391,432 B2 6/2008 Terada
7,400,578 B2 7/2008 Guthrie et al.
7,404,140 B2 7/2008 O' Rourke
7,421,470 B2 9/2008 Ludwig et al.
7,430,209 B2 9/2008 Porter
7,432,949 B2 10/2008 Remy et al.
7,433,921 B2 10/2008 Ludwig et al.
7,441,953 B2 10/2008 Banks
7,467,211 B1 12/2008 Herman et al.
7,483,867 B2 1/2009 Ansari et al.
7,492,731 B2 2/2009 Hagendorf
7,510,428 B2 3/2009 Obata et al.
7,523,069 B1 4/2009 Friedl et al.
7,525,281 B2 4/2009 Koyanagi et al.
7,535,486 B2 5/2009 Motomura et al.
7,557,758 B2 7/2009 Rofougaran
7,587,260 B2 9/2009 Bruemmer et al.
7,587,512 B2 9/2009 Ta et al.
7,590,060 B2 9/2009 Miceli
7,593,030 B2 9/2009 Wang et al.
7,599,290 B2 10/2009 Dos Remedios et al.
7,624,166 B2 11/2009 Foote et al.
7,630,314 B2 12/2009 Dos Remedios et al.
7,631,833 B1 12/2009 Ghaleb et al.
7,643,051 B2 1/2010 Sandberg et al.
7,647,320 B2 1/2010 Mok et al.
7,657,560 B1 2/2010 Dirienzo
7,680,038 B1 3/2010 Gourlay
7,693,757 B2 4/2010 Zimmerman
7,698,432 B2 4/2010 Short et al.
7,703,113 B2 4/2010 Dawson
7,719,229 B2 5/2010 Kaneko et al.
7,737,993 B2 6/2010 Kaasila et al.
7,739,383 B1 6/2010 Short et al.
7,756,614 B2 7/2010 Jouppi
7,761,185 B2 7/2010 Wang et al.
7,769,492 B2 8/2010 Wang et al.
7,769,705 B1 8/2010 Luechtefeld
7,774,158 B2 8/2010 Domingues Goncalves et al.
7,813,836 B2 10/2010 Wang et al.
7,831,575 B2 11/2010 Trossell et al.
7,835,775 B2 11/2010 Sawayama et al.
7,860,680 B2 12/2010 Arms et al.
7,861,366 B2 1/2011 Hahm et al.
7,885,822 B2 2/2011 Akers et al.
7,890,382 B2 2/2011 Robb et al.
7,912,583 B2 3/2011 Gutmann et al.
RE42,288 E 4/2011 Degioanni
7,924,323 B2 4/2011 Walker et al.
7,949,616 B2 5/2011 Levy et al.
7,956,894 B2 6/2011 Akers et al.
7,957,837 B2 6/2011 Ziegler et al.
7,982,763 B2 7/2011 King
7,982,769 B2 7/2011 Jenkins et al.
7,987,069 B2 7/2011 Rodgers et al.
8,077,963 B2 12/2011 Wang et al.
8,116,910 B2 2/2012 Walters et al.
8,126,960 B2 2/2012 Obradovich et al.
8,170,241 B2 5/2012 Roe et al.
8,179,418 B2 5/2012 Wright et al.
8,180,486 B2 5/2012 Saito et al.
8,209,051 B2 6/2012 Wang et al.
8,212,533 B2 7/2012 Ota
8,265,793 B2 9/2012 Cross et al.
8,287,522 B2 10/2012 Moses et al.
8,292,807 B2 10/2012 Perkins et al.
8,320,534 B2 11/2012 Kim et al.
8,340,654 B2 12/2012 Bratton et al.
8,340,819 B2 12/2012 Mangaser et al.
8,348,675 B2 1/2013 Dohrmann
8,374,171 B2 2/2013 Cho et al.
8,400,491 B1 3/2013 Panpaliya et al.
8,401,275 B2 3/2013 Wang et al.
8,423,284 B2 4/2013 O' Shea
8,451,731 B1 5/2013 Lee et al.
8,463,435 B2 6/2013 Herzog et al.
8,503,340 B1 8/2013 Xu
8,515,577 B2 8/2013 Wang et al.
8,527,094 B2 9/2013 Kumar et al.
8,532,860 B2 9/2013 Daly
8,610,786 B2 12/2013 Ortiz
8,612,051 B2 12/2013 Norman et al.
8,639,797 B1 1/2014 Pan et al.
8,670,017 B2 3/2014 Stuart et al.
8,726,454 B2 5/2014 Gilbert et al.
8,836,751 B2 9/2014 Ballantyne et al.
8,849,679 B2 9/2014 Wang et al.
8,849,680 B2 9/2014 Wright et al.
8,861,750 B2 10/2014 Roe et al.
8,897,920 B2 11/2014 Wang et al.
8,902,278 B2 12/2014 Pinter et al.
9,138,891 B2 9/2015 Herzog et al.
9,381,654 B2 7/2016 Herzog et al.
2001/0002448 A1 5/2001 Wilson et al.
2001/0010053 A1 7/2001 Ben-Shachar et al.
2001/0020200 A1 9/2001 Das et al.
2001/0034475 A1 10/2001 Flach et al.
2001/0034544 A1 10/2001 Mo

(56) **References Cited**

U.S. PATENT DOCUMENTS

2001/0037163 A1 11/2001 Allard
2001/0048464 A1 12/2001 Barnett
2001/0051881 A1 12/2001 Filler
2001/0054071 A1 12/2001 Loeb
2001/0055373 A1 12/2001 Yamashita
2002/0015296 A1 2/2002 Howell et al.
2002/0027597 A1 3/2002 Sachau
2002/0027652 A1 3/2002 Paromtchik et al.
2002/0033880 A1 3/2002 Sul et al.
2002/0038168 A1 3/2002 Kasuga et al.
2002/0044201 A1 4/2002 Alexander et al.
2002/0049517 A1 4/2002 Ruffner
2002/0055917 A1 5/2002 Muraca
2002/0057279 A1 5/2002 Jouppi
2002/0058929 A1 5/2002 Green
2002/0059587 A1 5/2002 Cofano et al.
2002/0063726 A1 5/2002 Jouppi
2002/0073429 A1 6/2002 Beane et al.
2002/0082498 A1 6/2002 Wendt et al.
2002/0085030 A1 7/2002 Ghani
2002/0095238 A1 7/2002 Ahlin et al.
2002/0095239 A1 7/2002 Wallach et al.
2002/0098879 A1 7/2002 Rheey
2002/0104094 A1 8/2002 Alexander et al.
2002/0106998 A1 8/2002 Presley et al.
2002/0109770 A1 8/2002 Terada
2002/0109775 A1 8/2002 White et al.
2002/0111988 A1 8/2002 Sato
2002/0120362 A1 8/2002 Lathan et al.
2002/0128985 A1 9/2002 Greenwald
2002/0130950 A1 9/2002 James et al.
2002/0133062 A1 9/2002 Arling et al.
2002/0141595 A1 10/2002 Jouppi
2002/0143923 A1 10/2002 Alexander
2002/0177925 A1 11/2002 Onishi et al.
2002/0183894 A1 12/2002 Wang et al.
2002/0184674 A1 12/2002 Xi et al.
2002/0186243 A1 12/2002 Ellis et al.
2003/0021107 A1 1/2003 Howell et al.
2003/0030397 A1 2/2003 Simmons
2003/0048481 A1 3/2003 Kobayashi et al.
2003/0050733 A1 3/2003 Wang et al.
2003/0050734 A1 3/2003 Lapham
2003/0060808 A1 3/2003 Wilk
2003/0063600 A1 4/2003 Noma et al.
2003/0069752 A1 4/2003 Ledain et al.
2003/0080901 A1 5/2003 Piotrowski
2003/0100892 A1 5/2003 Morley et al.
2003/0104806 A1 6/2003 Ruef et al.
2003/0112823 A1 6/2003 Collins et al.
2003/0114962 A1 6/2003 Niemeyer
2003/0120714 A1 6/2003 Wolff et al.
2003/0126361 A1 7/2003 Slater et al.
2003/0135097 A1 7/2003 Wiederhold et al.
2003/0135203 A1 7/2003 Wang et al.
2003/0144579 A1 7/2003 Buss
2003/0144649 A1 7/2003 Ghodoussi et al.
2003/0151658 A1 8/2003 Smith
2003/0152145 A1 8/2003 Kawakita
2003/0171710 A1 9/2003 Bassuk et al.
2003/0174285 A1 9/2003 Trumbull
2003/0180697 A1 9/2003 Kim et al.
2003/0195662 A1 10/2003 Wang et al.
2003/0199000 A1 10/2003 Valkirs et al.
2003/0206242 A1 11/2003 Choi
2003/0212472 A1 11/2003 Mckee
2003/0216833 A1 11/2003 Mukai et al.
2003/0216834 A1 11/2003 Allard
2003/0220541 A1 11/2003 Salisbury et al.
2003/0220715 A1 11/2003 Kneifel et al.
2003/0231244 A1 12/2003 Bonilla et al.
2003/0232649 A1 12/2003 Gizis et al.
2003/0236590 A1 12/2003 Park et al.
2004/0001197 A1 1/2004 Ko et al.
2004/0001676 A1 1/2004 Colgan et al.
2004/0008138 A1 1/2004 Hockley, Jr. et al.
2004/0010344 A1 1/2004 Hiratsuka et al.
2004/0012362 A1 1/2004 Tsurumi
2004/0013295 A1 1/2004 Sabe et al.
2004/0017475 A1 1/2004 Akers et al.
2004/0019406 A1 1/2004 Wang et al.
2004/0024490 A1 2/2004 Mclurkin et al.
2004/0041904 A1 3/2004 Lapalme et al.
2004/0065073 A1 4/2004 Nash
2004/0068657 A1 4/2004 Alexander et al.
2004/0078219 A1 4/2004 Kaylor et al.
2004/0080610 A1 4/2004 James et al.
2004/0088077 A1 5/2004 Jouppi et al.
2004/0088078 A1 5/2004 Jouppi et al.
2004/0093409 A1 5/2004 Thompson et al.
2004/0095516 A1 5/2004 Rohlicek
2004/0098167 A1 5/2004 Yi et al.
2004/0102167 A1 5/2004 Shim et al.
2004/0107254 A1 6/2004 Ludwig et al.
2004/0107255 A1 6/2004 Ludwig et al.
2004/0117065 A1 6/2004 Wang et al.
2004/0117067 A1 6/2004 Jouppi
2004/0123158 A1 6/2004 Roskind
2004/0135879 A1 7/2004 Stacy et al.
2004/0138547 A1 7/2004 Wang et al.
2004/0143421 A1 7/2004 Wang et al.
2004/0148638 A1 7/2004 Weisman et al.
2004/0150725 A1 8/2004 Taguchi
2004/0153211 A1 8/2004 Kamoto et al.
2004/0157612 A1 8/2004 Kim, II
2004/0162637 A1 8/2004 Wang et al.
2004/0167666 A1 8/2004 Wang et al.
2004/0167668 A1 8/2004 Wang et al.
2004/0168148 A1 8/2004 Gonsalves et al.
2004/0170300 A1 9/2004 Jouppi
2004/0172301 A1 9/2004 Mihai et al.
2004/0172306 A1 9/2004 Wohl et al.
2004/0174129 A1 9/2004 Wang et al.
2004/0175684 A1 9/2004 Kaasa et al.
2004/0179714 A1 9/2004 Jouppi
2004/0186623 A1 9/2004 Dooley et al.
2004/0189700 A1 9/2004 Mandavilli et al.
2004/0201602 A1 10/2004 Mody et al.
2004/0205664 A1 10/2004 Prendergast
2004/0215490 A1 10/2004 Duchon et al.
2004/0218099 A1 11/2004 Washington
2004/0222638 A1 11/2004 Bednyak
2004/0224676 A1 11/2004 Iseki
2004/0230340 A1 11/2004 Fukuchi et al.
2004/0240981 A1 12/2004 Dothan et al.
2004/0241981 A1 12/2004 Doris et al.
2004/0260790 A1 12/2004 Balloni et al.
2005/0003330 A1 1/2005 Asgarinejad et al.
2005/0004708 A1 1/2005 Goldenberg et al.
2005/0007445 A1 1/2005 Foote et al.
2005/0013149 A1 1/2005 Trossell
2005/0021182 A1 1/2005 Wang et al.
2005/0021183 A1 1/2005 Wang et al.
2005/0021187 A1 1/2005 Wang et al.
2005/0021309 A1 1/2005 Alexander et al.
2005/0024485 A1 2/2005 Castles et al.
2005/0027567 A1 2/2005 Taha
2005/0027794 A1 2/2005 Decker
2005/0028221 A1 2/2005 Liu et al.
2005/0035862 A1 2/2005 Wildman et al.
2005/0038416 A1 2/2005 Wang et al.
2005/0038564 A1 2/2005 Burick
2005/0049898 A1 3/2005 Hirakawa
2005/0052527 A1 3/2005 Remy et al.
2005/0060211 A1 3/2005 Xiao et al.
2005/0065435 A1 3/2005 Rauch et al.
2005/0065438 A1 3/2005 Miller
2005/0065659 A1 3/2005 Tanaka et al.
2005/0065813 A1 3/2005 Mishelevich et al.
2005/0071046 A1 3/2005 Miyazaki et al.
2005/0073575 A1 4/2005 Thacher et al.
2005/0078816 A1 4/2005 Sekiguchi et al.
2005/0083011 A1 4/2005 Yang et al.
2005/0099493 A1 5/2005 Chew

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0104964 A1 5/2005 Bovyrin et al.
2005/0110867 A1 5/2005 Schulz
2005/0122390 A1 6/2005 Wang et al.
2005/0125083 A1 6/2005 Kiko
2005/0125098 A1 6/2005 Wang et al.
2005/0149364 A1 7/2005 Ombrellaro
2005/0152447 A1 7/2005 Jouppi et al.
2005/0152565 A1 7/2005 Jouppi et al.
2005/0154265 A1 7/2005 Miro et al.
2005/0168568 A1 8/2005 Jouppi
2005/0182322 A1 8/2005 Grispo
2005/0192721 A1 9/2005 Jouppi
2005/0204438 A1 9/2005 Wang et al.
2005/0212478 A1 9/2005 Takenaka
2005/0219356 A1 10/2005 Smith et al.
2005/0225634 A1 10/2005 Brunetti et al.
2005/0231156 A1 10/2005 Yan
2005/0231586 A1 10/2005 Rodman et al.
2005/0232647 A1 10/2005 Takenaka
2005/0234592 A1 10/2005 Mcgee et al.
2005/0264649 A1 12/2005 Chang et al.
2005/0267826 A1 12/2005 Levy et al.
2005/0283414 A1 12/2005 Fernandes et al.
2005/0286759 A1 12/2005 Zitnick et al.
2006/0007943 A1 1/2006 Fellman
2006/0010028 A1 1/2006 Sorensen
2006/0013263 A1 1/2006 Fellman
2006/0013469 A1 1/2006 Wang et al.
2006/0013488 A1 1/2006 Inoue
2006/0014388 A1 1/2006 Lur et al.
2006/0020694 A1 1/2006 Nag et al.
2006/0029065 A1 2/2006 Fellman
2006/0047365 A1 3/2006 Ghodoussi et al.
2006/0048286 A1 3/2006 Donato
2006/0052676 A1 3/2006 Wang et al.
2006/0052684 A1 3/2006 Takahashi et al.
2006/0056655 A1 3/2006 Wen et al.
2006/0056837 A1 3/2006 Vapaakoski
2006/0064212 A1 3/2006 Thorne
2006/0066609 A1 3/2006 Iodice et al.
2006/0071797 A1 4/2006 Rosenfeld et al.
2006/0074525 A1 4/2006 Close et al.
2006/0074719 A1 4/2006 Homer
2006/0082642 A1 4/2006 Wang et al.
2006/0087746 A1 4/2006 Lipow
2006/0095158 A1* 5/2006 Lee H04M 1/72533 700/245
2006/0095170 A1 5/2006 Yang et al.
2006/0098573 A1 5/2006 Beer et al.
2006/0103659 A1 5/2006 Karandikar et al.
2006/0104279 A1 5/2006 Fellman et al.
2006/0106493 A1 5/2006 Niemeyer et al.
2006/0122482 A1 6/2006 Mariotti et al.
2006/0125356 A1 6/2006 Meek et al.
2006/0142983 A1 6/2006 Sorensen et al.
2006/0149418 A1 7/2006 Anvari
2006/0161136 A1 7/2006 Anderson
2006/0161303 A1 7/2006 Wang et al.
2006/0164546 A1 7/2006 Adachi
2006/0171515 A1 8/2006 Hintermeister et al.
2006/0173708 A1 8/2006 Vining et al.
2006/0173712 A1 8/2006 Joubert
2006/0178559 A1 8/2006 Kumar et al.
2006/0178776 A1 8/2006 Feingold et al.
2006/0178777 A1 8/2006 Park et al.
2006/0189393 A1 8/2006 Edery
2006/0195569 A1 8/2006 Barker
2006/0224781 A1 10/2006 Tsao et al.
2006/0247045 A1 11/2006 Jeong et al.
2006/0259193 A1 11/2006 Wang et al.
2006/0268704 A1 11/2006 Ansari et al.
2006/0271238 A1 11/2006 Choi et al.
2006/0271400 A1 11/2006 Clements et al.
2006/0293788 A1 12/2006 Pogodin
2007/0021871 A1 1/2007 Wang et al.
2007/0025711 A1 2/2007 Marcus
2007/0046237 A1 3/2007 Lakshmanan et al.
2007/0050937 A1 3/2007 Song et al.
2007/0064092 A1 3/2007 Sandbeg et al.
2007/0078566 A1 4/2007 Wang et al.
2007/0093279 A1 4/2007 Janik
2007/0112700 A1* 5/2007 Den Haan G05D 1/024 706/14
2007/0116152 A1 5/2007 Thesling
2007/0117516 A1 5/2007 Saidi et al.
2007/0120965 A1 5/2007 Sandberg et al.
2007/0122783 A1 5/2007 Habashi
2007/0133407 A1 6/2007 Choi et al.
2007/0135967 A1 6/2007 Jung et al.
2007/0142964 A1 6/2007 Abramson
2007/0170886 A1 7/2007 Plishner
2007/0176060 A1 8/2007 White et al.
2007/0192910 A1 8/2007 Vu et al.
2007/0197896 A1 8/2007 Moll et al.
2007/0198128 A1 8/2007 Ziegler et al.
2007/0198130 A1 8/2007 Wang et al.
2007/0199108 A1 8/2007 Angle et al.
2007/0216347 A1 9/2007 Kaneko et al.
2007/0226949 A1 10/2007 Hahm et al.
2007/0250212 A1* 10/2007 Halloran A47L 5/30 700/245
2007/0255706 A1 11/2007 Iketani et al.
2007/0262884 A1 11/2007 Goncalves et al.
2007/0273751 A1 11/2007 Sachau
2007/0290040 A1 12/2007 Wurman et al.
2007/0291109 A1 12/2007 Wang et al.
2007/0291128 A1 12/2007 Wang et al.
2008/0009969 A1 1/2008 Bruemmer et al.
2008/0011904 A1 1/2008 Cepollina et al.
2008/0027591 A1 1/2008 Lenser et al.
2008/0033641 A1 2/2008 Medalia
2008/0045804 A1 2/2008 Williams
2008/0051985 A1 2/2008 D'Andrea et al.
2008/0065268 A1 3/2008 Wang et al.
2008/0082211 A1 4/2008 Wang et al.
2008/0086241 A1 4/2008 Phillips et al.
2008/0091340 A1 4/2008 Milstein et al.
2008/0126132 A1 5/2008 Warner et al.
2008/0133052 A1 6/2008 Jones et al.
2008/0161969 A1 7/2008 Lee et al.
2008/0174570 A1 7/2008 Jobs et al.
2008/0201016 A1 8/2008 Finlay
2008/0201017 A1 8/2008 Wang et al.
2008/0215987 A1 9/2008 Alexander et al.
2008/0229531 A1 9/2008 Takida
2008/0232763 A1 9/2008 Brady
2008/0255703 A1 10/2008 Wang et al.
2008/0263451 A1 10/2008 Portele et al.
2008/0263628 A1 10/2008 Norman et al.
2008/0267069 A1 10/2008 Thielman et al.
2008/0269949 A1* 10/2008 Norman G08C 17/02 700/248
2008/0281467 A1 11/2008 Pinter
2008/0306375 A1 12/2008 Sayler et al.
2009/0030552 A1 1/2009 Nakadai et al.
2009/0044334 A1 2/2009 Parsell et al.
2009/0049640 A1 2/2009 Lee et al.
2009/0055023 A1 2/2009 Walters et al.
2009/0070135 A1 3/2009 Panda et al.
2009/0086013 A1 4/2009 Thapa
2009/0102919 A1 4/2009 Zamierowski et al.
2009/0105882 A1 4/2009 Wang et al.
2009/0106679 A1 4/2009 Anzures et al.
2009/0122699 A1 5/2009 Alperovitch et al.
2009/0125147 A1 5/2009 Wang et al.
2009/0144425 A1 6/2009 Marr et al.
2009/0164255 A1 6/2009 Menschik et al.
2009/0164657 A1 6/2009 Li et al.
2009/0171170 A1 7/2009 Li et al.
2009/0177323 A1 7/2009 Ziegler et al.
2009/0177641 A1 7/2009 Raghavan
2009/0237317 A1 9/2009 Rofougaran
2009/0240371 A1 9/2009 Wang et al.
2009/0248200 A1 10/2009 Root

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0259339	A1	10/2009	Wright et al.
2010/0010672	A1	1/2010	Wang et al.
2010/0010673	A1	1/2010	Wang et al.
2010/0017046	A1	1/2010	Cheung et al.
2010/0019715	A1	1/2010	Roe et al.
2010/0026239	A1	2/2010	Li et al.
2010/0030578	A1	2/2010	Siddique et al.
2010/0051596	A1	3/2010	Diedrick et al.
2010/0063848	A1	3/2010	Kremer et al.
2010/0066804	A1	3/2010	Shoemake et al.
2010/0070079	A1	3/2010	Mangaser et al.
2010/0073490	A1	3/2010	Wang et al.
2010/0076600	A1	3/2010	Cross et al.
2010/0085874	A1	4/2010	Noy et al.
2010/0088232	A1	4/2010	Gale
2010/0115418	A1	5/2010	Wang et al.
2010/0116566	A1	5/2010	Ohm et al.
2010/0131102	A1	5/2010	Herzog et al.
2010/0131103	A1	5/2010	Herzog et al.
2010/0145479	A1	6/2010	Griffiths
2010/0157825	A1	6/2010	Anderlind et al.
2010/0171826	A1	7/2010	Hamilton et al.
2010/0191375	A1	7/2010	Wright et al.
2010/0228249	A1	9/2010	Mohr et al.
2010/0268383	A1	10/2010	Wang et al.
2010/0278086	A1	11/2010	Pochiraju et al.
2010/0286905	A1	11/2010	Goncalves et al.
2010/0301679	A1	12/2010	Murray et al.
2010/0323783	A1	12/2010	Nonaka et al.
2011/0022705	A1	1/2011	Yellamraju et al.
2011/0050841	A1	3/2011	Wang et al.
2011/0071675	A1	3/2011	Wells et al.
2011/0071702	A1	3/2011	Wang et al.
2011/0072114	A1	3/2011	Hoffert et al.
2011/0153198	A1	6/2011	Kokkas et al.
2011/0172822	A1	7/2011	Ziegler et al.
2011/0187875	A1	8/2011	Sanchez et al.
2011/0190930	A1	8/2011	Hanrahan et al.
2011/0193949	A1	8/2011	Nambakam et al.
2011/0195701	A1	8/2011	Cook et al.
2011/0213210	A1	9/2011	Temby et al.
2011/0218674	A1	9/2011	Stuart et al.
2011/0245973	A1	10/2011	Wang et al.
2011/0280551	A1	11/2011	Sammon
2011/0292193	A1	12/2011	Wang et al.
2011/0301759	A1	12/2011	Wang et al.
2011/0306400	A1	12/2011	Nguyen
2012/0023506	A1	1/2012	Maeckel et al.
2012/0036484	A1	2/2012	Zhang et al.
2012/0059946	A1	3/2012	Wang
2012/0072023	A1	3/2012	Ota
2012/0072024	A1	3/2012	Wang et al.
2012/0092157	A1	4/2012	Tran
2012/0095352	A1	4/2012	Tran
2012/0113856	A1	5/2012	Krishnaswamy
2012/0191246	A1	7/2012	Roe et al.
2012/0191464	A1	7/2012	Stuart et al.
2012/0203731	A1	8/2012	Nelson et al.
2012/0291809	A1	11/2012	Kuhe et al.
2013/0250938	A1	9/2013	Anandakumar et al.
2014/0047022	A1	2/2014	Chan et al.
2014/0085543	A1	3/2014	Hartley et al.
2014/0135990	A1	5/2014	Stuart et al.
2014/0139616	A1	5/2014	Pinter et al.
2014/0155755	A1	6/2014	Pinter et al.
2014/0156078	A1	6/2014	Herzog et al.
2015/0352722	A1	12/2015	Herzog et al.

FOREIGN PATENT DOCUMENTS

CN	1404695	A	3/2003
CN	1554193	A	12/2004
CN	1554985	A	12/2004
CN	1561923	A	1/2005
CN	1743144	A	3/2006
CN	101049017	A	10/2007
CN	101106939	A	1/2008
CN	101151614	A	3/2008
CN	100407729	C	7/2008
CN	101390098	A	3/2009
CN	101507260	A	8/2009
CN	101730894	A	6/2010
CN	101866396	A	10/2010
CN	101978365	A	2/2011
CN	102203759	A	9/2011
CN	101106939	B	11/2011
EP	466492	A2	1/1992
EP	488673	A2	6/1992
EP	981905	B1	1/2002
EP	1262142	A2	12/2002
EP	1304872	A1	4/2003
EP	1536660	A2	6/2005
EP	1573406	A2	9/2005
EP	1594660	A2	11/2005
EP	1763243	A2	3/2007
EP	1791464	A2	6/2007
EP	1800476	A2	6/2007
EP	1819108	A2	8/2007
EP	1856644	A2	11/2007
EP	1536660	A3	4/2008
EP	1928310	A2	6/2008
EP	1232610	B1	1/2009
EP	2027716	A2	2/2009
EP	2145274	A1	1/2010
EP	2214111	A2	8/2010
EP	2263158	A2	12/2010
EP	2300930	A1	3/2011
EP	2342651	A1	7/2011
GB	2431261	A	4/2007
JP	7-194609	A	8/1995
JP	7-213753	A	8/1995
JP	7-248823	A	9/1995
JP	7-257422	A	10/1995
JP	8-084328	A	3/1996
JP	8-320727	A	12/1996
JP	9-267276	A	10/1997
JP	10-79097	A	3/1998
JP	10-288689	A	10/1998
JP	11-220706	A	8/1999
JP	2000-032319	A	1/2000
JP	2000-049800	A	2/2000
JP	2000-079587	A	3/2000
JP	2000-196876	A	7/2000
JP	2001-88124	A	4/2001
JP	2001-125641	A	5/2001
JP	2001-147718	A	5/2001
JP	2001-179663	A	7/2001
JP	2001-188124	A	7/2001
JP	2001-198865	A	7/2001
JP	2001-198868	A	7/2001
JP	2001-199356	A	7/2001
JP	2002-000574	A	1/2002
JP	2002-035423	A	2/2002
JP	2002-046088	A	2/2002
JP	2002-101333	A	4/2002
JP	2002-112970	A	4/2002
JP	2002-235423	A	8/2002
JP	2002-305743	A	10/2002
JP	2002-321180	A	11/2002
JP	2002-355779	A	12/2002
JP	2004-181229	A	7/2004
JP	2004-524824	T	8/2004
JP	2004-261941	A	9/2004
JP	2004-289379	A	10/2004
JP	2005-028066	A	2/2005
JP	2005-059170	A	3/2005
JP	2005-111083	A	4/2005
JP	2006-508806	A	3/2006
JP	2006-109094	A	4/2006
JP	2006-224294	A	8/2006
JP	2006-246438	A	9/2006
JP	2007-007040	A	1/2007
JP	2007-081646	A	3/2007
JP	2007-232208	A	9/2007

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2007-316966	A	12/2007
JP	2009-125133	A	6/2009
JP	2010-064154	A	3/2010
JP	2010-532109	A	9/2010
JP	2010-246954	A	11/2010
KR	2006-0037979	A	5/2006
KR	2009-0012542	A	2/2009
KR	2010-0019479	A	2/2010
KR	2010-0139037	A	12/2010
WO	93/06690	A1	4/1993
WO	97/42761	A1	11/1997
WO	1998/51078	A1	11/1998
WO	99/67067	A1	12/1999
WO	2000/025516	A1	5/2000
WO	2000/033726	A1	6/2000
WO	01/31861	A1	5/2001
WO	2003/077745	A1	9/2003
WO	2004/008738	A1	1/2004
WO	2004/012018	A2	2/2004
WO	2004/075456	A2	9/2004
WO	2006/012797	A1	2/2006
WO	2006/044847	A2	4/2006
WO	2006/078611	A2	7/2006
WO	2007/041295	A2	4/2007
WO	2007/041038	A3	6/2007
WO	2008/100272	A2	8/2008
WO	2008/100272	A3	10/2008
WO	2009/117274	A2	9/2009
WO	2009/128997	A1	10/2009
WO	2009/145958	A2	12/2009
WO	2010/006205	A1	1/2010
WO	2010/006211	A1	1/2010
WO	2010/033666	A1	3/2010
WO	2010/047881	A1	4/2010
WO	2010/062798	A1	6/2010
WO	2010/065257	A1	6/2010
WO	2010/120407	A1	10/2010
WO	2011/028589	A2	3/2011
WO	2011/028589	A3	4/2011
WO	2011/097130	A2	8/2011
WO	2011/097132	A2	8/2011
WO	2011/109336	A2	9/2011
WO	2011/097132	A3	12/2011
WO	2011/149902	A2	12/2011
WO	2011/149902	A3	2/2012

OTHER PUBLICATIONS

Paulos et al., "Ubiquitous Tele-Embodiment: Applications and Implications", International Journal of Human Computer Studies, vol. 46, No. 6, Jun. 1997, pp. 861-877.

Paulos, Eric John Canny, "Video of PRoP 2 at Richmond Field Station", www.prop.org Printout of Home Page of Website and two-page Transcript of the audio portion of said PRoP Video, May 2001, 2 pages.

Picturetel Corporation, "PictureTel Live200 for Windows NT Product Guide", 1997, 63 pages.

Pin et al., "A New Family of Omnidirectional and Holonomic Wheeled Platforms for Mobile Robots", IEEE Transactions on Robotics and Automation, vol. 10, No. 4, Aug. 1994, pp. 480-489.

Piquepaille, Roland, "This Blog and its RSS Feed Are Moving", Roland Piquepaille's Technology Trends, How new technologies are modifying our way of life, Oct. 31, 2004, 2 pages.

Zamrazil, Kristie, "Telemedicine in Texas: Public Policy Concerns", Focus Report, House Research Organization, Texas House of Representatives, No. 76-22, May 5, 2000, pp. 1-16.

Zipperer, Lorri, "Robotic Dispensing System", ISMP Medication Safety Alert!, vol. 4, No. 17, Aug. 25, 1999, 2 pages.

Zorn, Benjamin G., "Ubiquitous Telepresence", Department of Computer Science, University of Colorado, 1996, 13 pages.

"NetMeeting", available online at <http://web.archive.orgjweb/20060417235555/http://transcriptions.english>, Apr. 17, 2006, 2 pages.

West et al., "Design of Ball Wheel Mechanisms for Omnidirectional Vehicles with Full Mobility and Invariant Kinematics", Journal of Mechanical Design, vol. 119, Jun. 1997, pp. 153-161.

Radvision, "Making Sense of Bandwidth the Netsense Way", Network Congestion in Unmanaged Networks Bandwidth Estimation and Adaptation Techniques,White Paper, Radvision's Netsense Technology, 2010, 7 pages.

Reynolds et al., "Review of Robotic Telemedicine Utilization in Intensive Care Units (ICUs)", 11th Annual ATA Symposium, Tampa, Florida, 2011, 1 page.

Roach, Adam, "Automatic Call Back Service in SIP", Internet Engineering Task Force, Internet Draft, Category: Informational, Mar. 2000, 8 pages.

Rovetta et al., "A New Telerobotic Application: Remote Laparoscopic Surgery Using Satellites and optical fiber Networks for Data Exchange", International Journal of Robotics Research, vol. 15, No. 3, Jun. 1, 1996, pp. 267-279.

Roy et al., "Towards Personal Service Robots for the Elderly", Workshop on Interactive Robots and Entertainment (WIRE 2000), available online at <http://www.ri.cmu.edu/pb_files/pub2/roy_nicholas_2000_1/roy_nicholas_2000_1.pdf>, vol. 25, Apr. 30-May 1, 2000, 7 pages.

Sachs et al., "Virtual Visit: Improving Communication for Those Who Need it Most", Studies in Health Technology and Informatics, vol. 94, Medicine Meets Virtual Reality 11, 2003, pp. 302-308.

Salemi et al., "MILO: Personal Robot Platform", IEEE/RSJ International Conference on Intelligent Robots and Systems, Aug. 2005, pp. 4089-4094.

Sandt et al., "Perceptions for a Transport Robot in Public Environments", Proceedings of the 1997 IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, Sep. 7-11, 1997, pp. 360-365.

Sawyer, Robert J., "Inventing the Future: 2000 Years of Discovery", available online at <http://www.sfwriter.com/pritf.htm>, Jan. 2, 2000, 2 pages.

Schaeffer et al., "Care-O-BotTM: The Concept of a System for Assisting Elderly or Disabled Persons in Home Environments", Proceedings of the 24th Annual Conference of the IEEE Industrial Electronics Society, vol. 4, 1998, pp. 2476-2481.

Schraft et al., "Care-O-bot™; The Concept of a System for Assisting Elderly or Disabled Persons in Home Environments", IEEE Proceedings of the 24th Annual Conference of the Industrial Electronics Society, IECON '98, Aug. 31-Sep. 4, 1998, pp. 2476-2481.

Schultz et al., "Web Interfaces for Mobile Robots in Public Places", IEEE Robotics & Automation Magazine, vol. 7, No. 1, Mar. 2000, pp. 48-56.

Shimoga et al., "Touch and Force Reflection for Telepresence Surgery", Proceedings of the 16th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Nov. 1994, pp. 1049-1050.

Siegwart et al., "Interacting Mobile Robots on the Web", Proceedings of the 1999 IEEE International Conference on Robotics and Automation, May 1999, pp. 1-7.

Simmons et al., "Xavier: An Autonomous Mobile Robot on the Web", IEEE Robotics and Automation Magazine, 1999, pp. 43-48.

Stephenson, Gary, "Dr. Robot Tested at Hopkins", available online at <http://www.hopkinsmedicine.org/press/2003/august/030805.htm>, Aug. 5, 2003, 2 pages.

Stoianovici et al., "Robotic Tools for Minimally Invasive Urologic Surgery", Complications of Urologic Laparoscopic Surgery: Recognition, Management and Prevention, Dec. 2002, 17 pages.

Suplee, Curt, "Mastering the Robot", The Washington Post, Washington Post Staff Writer, Sep. 17, 2000, 5 pages.

Tahboub et al., "Dynamics Analysis and Control of a Holonomic Vehicle With Continuously Variable Transmission", Transactions of the ASME, Journal of Dynamic Systems, Measurement and Control, vol. 124, Mar. 2002, pp. 118-126.

Telepresence Research, Inc., "The Telepresence Mobile Robot System", Available online at <http://www.telepresence.com/telepresence-research/TELEROBOT/>, Feb. 20, 1995, 3 pages.

Tendick et al., "Human-Machine Interfaces for Minimally Invasive Surgery", Proceedings of the 19th Annual International Conference

(56) **References Cited**

OTHER PUBLICATIONS

of the IEEE Engineering in Medicine and Biology Society, vol. 6, Oct. 30-Nov. 2, 1997, pp. 2771-2776.
Theodosiou et al., "MuLVAT: A Video Annotation Tool Based on XML-Dictionaries and Shot Clustering", 19th International Conference, Artificial Neural Networks—ICANN 2009, Part II, Sep. 14-17, 2009, pp. 913-922.
Thrun et al., "Probabilistic Algorithms and the Interactive Museum Tour-Guide Robot Minerva", International Journal of Robotics Research, vol. 19, 2000, pp. 1-35.
Time, Lists, "Office Coworker Robot", Best Inventions of 2001, available online at <http://content.time.com/time/specials/packages/article/0,28804,1936165_1936255_1936640,00.html>, Nov. 19, 2001, 2 pages.
Tipsuwan et al., "Gain Adaptation of Networked Mobile Robot to Compensate QoS Deterioration", 28th Annual Conference of the Industrial Electronics Society, vol. 4, Nov. 5-8, 2002, pp. 3146-3151.
Tsui et al., "Exploring Use Cases for Telepresence Robots", 6th ACM/IEEE International Conference on Human-Robot Interaction (HRI), Mar. 2011, pp. 11-18.
Tyrrell et al., "Teleconsultation in Psychology: The Use of Videolinks for Interviewing and Assessing Elderly Patients", Age and Ageing, vol. 30, No. 3, May 2001, pp. 191-195.
Tzafestas et al., "VR-Based Teleoperation of a Mobile Robotic Assistant: Progress Report", Technical Report DEMO 2000/13, Institute of Informatics and Telecommunications, National Center for Scientific Research "Demokritos", Nov. 2000, pp. 1-23.
UMASS Lowell Robotics Lab, "Robotics Lab @ UMASS Lowell", Brochure, 2011, 2 pages.
Urquhart, Kim, "InTouch's Robotic Companion 'Beams Up' Healthcare Experts", Medical Device Daily, vol. 7, No. 39, Feb. 27, 2003, pp. 1, 4.
Video Middleware Cookbook, "H.350 Directory Services for Multimedia", 2 pages.
Weaver et al., "Monitoring and Controlling Using the Internet and Java", Proceedings of the 25th Annual Conference of the IEEE Industrial Electronics Society, vol. 3, 1999, pp. 1152-1158.
Weiss et al., "PEBBLES: A Personal Technology for Meeting Education, Social and Emotional Needs of Hospitalised Children", Personal and Ubiquitous Computing, vol. 5, No. 3, Aug. 2001, pp. 157-168.
Weiss et al., "Telework and Video-Mediated Communication: Importance of Real-Time, Interactive Communication for Workers with Disabilities", available online at <http://www.telbotics.com/research_3.htm>, retrieved on Nov. 23, 2010, 3 pages.
Cleary et al., "State of the Art in Surgical Robotics: Clinical Applications and Technology Challenges", Feb. 24, 2002, pp. 1-26.
CMU Course 16X62, "Robot user's manual", (describing the Nomad Scout), Carnegie Mellon University, Feb. 1, 2001,11 pages.
CNN, "Floating 'Droids' to Roam Space Corridors of the Future", Available online at <http://edition.cnn.com/2000/TECH/space/01/12/psa/>, Jan. 12, 2000, 3 pages.
CNN.com, "Paging Dr.Robot: Machine Helps Doctors with Patients", Sep. 30, 2003, 3 pages.
Crowley, Susan L., "Hello to Our Future", AARP Bulletin, Jan. 2000, 12 pages.
Dalton, Barnaby, "Techniques for Web Telerobotics", PhD Thesis, University of Western Australia, 2001, 243 pages.
Dario et al., "A Robot Workstation for Diagnosis and Physical Therapy", IEEE Catalog No. 88TH0234-5, 1989, pp. 67-72.
Davies, Brian, "Robotics in Minimally Invasive Surgery", IEE Colloquium on Through the Keyhole: Microengineering in Minimally Invasive Surgery, 1995, pp. 1-2.
Davis, Erik, "Telefriend, Meet iRobot, The Smartest Webcam on Wheels", Wird Magazine, Issue 8.09, Available online at <http://www.wired.com/wired/archive/8.09/irobot.html?pg=1&topic=&topic_set=>, Sep. 2000, 3 pages.
Dean et al., "1992 AAAI Robot Exhibition and Competition", Articles, AI Magazine, vol. 14, No. 1, 1993, 15 pages.
Digiorgio, James, "Is Your Emergency Department of the Leading Edge?", Chicago Hospital News, vol. 2, No. 12, 2005, 3 pages.
Dudenhoeffer et al., "Command and Control Architectures for Autonomous Micro- Robotic Forces", FY00 Project Report, Idaho National Engineering and Environmental Laboratory Human Systems Engineering and Sciences Department, Idaho Falls, Apr. 2001, 43 pages.
Elhajj et al., "Real-Time Haptic Feedback in Internet-Based Telerobotic Operation", IEEE International Conference on Electro/Information Technology, available online at <http://www.egr.msu.edu/~ralab-web/cgi_bin/internet-teleoperation.php>, Jun. 2000, 10 pages.
Elhajj et al., "Supermedia in Internet-Based Telerobitc Operations", Management of Multimedia on InternetLecture Notes in Computer Science, Springer-Verlag Berlin Heidelberg, vol. 2216, Oct. 29-Nov. 1, 2001, pp. 359-372.
Elhajj et la., "Synchronization and Control of Supermedia Transmission Via the Internet", Proceedings of 2001 International Symposium on Intelligent Multimedia Video and Speech Proecessing, May 2-4, 2001, pp. 320-323.
Ellison et al., "Telerounding and Patient Satisfaction Following Surgery", vol. 199, No. 4, Oct. 2004, pp. 523-530.
Evans et al., "The Trackless Robotic Courier", PYXIS HelpMate®, 2007, 3 pages.
Fels et al., "Developing a Video-Mediated Communication System for Hospitalized Children", Telemedicine Journal, vol. 5, No. 2, 1999, 30 pages.
Fetterman et al., "Videoconferencing Over the Internet", 2001, 8 pages.
Fiorini et al., "Health Care Robotics: A Progress Report", IEEE International Conference on Robotics and Automation, Apr. 20-25, 1997, pp. 1271-1276.
Fong, Terrence, "Collaborative Control: A Robot-Centric Model for Vehicle Teleoperation", Doctoral Dissertation, Technical Report CMU-RI-TR-01-34, Robotics Institute, Carnegie Mellon University, Nov. 2001, 197 pages.
Fulbright et al., "SWAMI: An Autonomous Mobile Robot for Inspection of Nuclear Waste of Storage Facilities", Autonomous Robots, vol. 2, 1995, pp. 225-235.
Gaidioz et al., "Synchronizing Network Probes to Avoid Measurement Intrusiveness with the Network Weather Service", Proceedings of the Ninth International Symposium on High-Performance Distributed Computing, 2000, pp. 147-154.
Garner et al., "The Application of Telepresence in Medicine", BT Technology Journal, vol. 15, No. 4, Oct. 1, 1997, pp. 181-187.
Ghiasi et al., "A Generic Web-based Teleoperations Architecture: Details and Experience", Proceedings of SPIE, Telemanipulator and Telepresence Technologies VI, vol. 3840, No. 234, Sep. 19, 1999, 14 pages.
Goldberg et al., "Collaborative Teleoperation via the Internet", IEEE International Conference on Robotics and Automation (ICRA), vol. 2, 2000, pp. 2019-2024.
Goldberg et al., "Desktop Teleoperation via the World Wide Web", IEEE International Conference on Robotics and Automation, vol. 1, May 21-27, 1995, pp. 654-659.
Goldenberg et al., "Telemedicine in Otolaryngology", American Journal of Otolaryngology, vol. 23, No. 1, 2002, pp. 35-43.
Goldman, Lea, "Machine Dreams", available online at <http://www.forbes.com/global/2002/0527043html>, May 27, 2002, 5 pages.
Gostai, "Gostai Jazz: Robotic Telepresence", available online at <http://www.robotshop.com/media/files/pdf/gostai-jazz-information-sheet.pdf>, 4 pages.
Gump, Michael, D., "Robot Technology Improves VA Pharmacies", U.S. Medicine Informational Central, Jul. 2001, 3 pages.
Al-Kassab et al., "A Review of Telemedicine", Journal of Telemedicine and Telecare, vol. 5, Supplement 1, 1999, pp. 103-106.
Han et al., "Construction of an Omnidirectional Mobile Robot Platform Based on Active Dual-Wheel Caster Mechanisms and Development of a Control Simulator", Journal of Intelligent and Robotic Systems, vol. 29, Issue 3, Nov. 2000, pp. 257-275.

(56) **References Cited**

OTHER PUBLICATIONS

Handley et al., "RFC 2327—SDP: Session Description Protocol", available online at <http://www.faqs.org/rfcs/rfc2327.html>, Apr. 1998, 22 pages.
Hanebeck et al., "ROMAN: A Mobile Robotic Assistant for Indoor Service Applications", IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, Sep. 7-11, 1997, pp. 518-525.
Harmo et al., "Moving Eye-Interactive Telepresence Over Internet With a Ball Shaped Mobile Robot", available online at <http://automation.tkk.fi/files/tervetaas/MovingEye4.pdf>, 2000, 6 pages.
Haule et al., "Control Scheme for Delayed Teleoperation Tasks", IEEE Pacific Rim Conference on Communications, Computers, and Signal Processing, May 17-19, 1995, pp. 157-160.
Hees, William P., "Communications Design for a Remote Presence Robot", CSCI E-131b, Final Project, Jan. 14, 2002, 12 pages.
Herias et al., "Flexible Virtual and Remote Laboratory for Teaching Robotics", Current Developments in Technology-Assisted Education, Jun. 2006, pp. 1959-1963.
Holmberg et al., "Development of a Holonomic Mobile Robot for Mobile Manipulation Tasks", International Journal of Robotics Research, vol. 19, No. 11, Nov. 2000, pp. 1066-1074.
Ishiguro et al., "Integrating a Perceptual Information Infrastructure with Robotic Avatars: A Framework for Tele-Existence", IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, 1999, pp. 1032-1038.
Ishihara et al., "Intelligent Microrobot DDS (Drug Delivery System) Measured and Controlled by Ultrasonics", Intelligent Robots and Systems '91. Intelligence for Mechanical Systems, IEEE/RSJ International Workshop, vol. 2, Nov. 3-5, 1991, pp. 1145-1150.
ITU, "Call Completion Supplementary Services for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.9, Series H: Audiovisual and Multimedia Systems, Nov. 2000, 63 pages.
ITU, "Call Intrusion Supplementary Service for H.323", ITU-T, Telecommunication Standardization Sector of ITU, H.450.11, Series H: Audiovisual and Multimedia Systems, Mar. 2001, 59 pages,
ITU, "Packet-Based Multimedia Communications Systems", ITU-T, Telecommunication Standardization Sector of ITU, H.323, Series H: Audiovisual and Multimedia Systems, Feb. 1998, 128 pages.
ITU, "Transmission of Non-Telephone Signals: A Far End Camera Control Protocol for Videoconferences Using H.224", ITU-T, Telecommunication Standardization Sector of ITU, H.281, Nov. 1994, 12 pages.
Ivanova, Natali, "Master's Thesis: Internet Based Interface for Control of a Mobile Robot", Department of Numerical Analysis and Computer Science, 2003, 59 pages.
Jacobs et al., "Applying Telemedicine to Outpatient Physical Therapy", AMIA, Annual Symposium Proceedings, 2002, 1 page.
Jenkins et al., "Telehealth Advancing Nursing Practice", Nursing Outlook, vol. 49, No. 2, Mar. 2001, pp. 100-105.
Johanson, Mathias, "Supporting Video-Mediated Communication Over the Internet", Department of Computer Engineering, Chalmers University of Technology, Gothenburg, Sweden, 2003, 222 pages.
Screenshot Showing Google Date for Lemaire Telehealth Manual, screenshot retrieved on Dec. 18, 2014, 1 page.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. I of IV, Jun. 24, 2013, pp. A1-A6357.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. II of IV, Jun. 24, 2013, pp. A6849-A10634.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. III of IV, Jun. 24, 2013, pp. A10654-A15517.
Appeal from the U.S. District Court for the Central District of California in case No. 11-cv-9185, Judge Percy Anderson, Joint Appendix, vol. IV of IV, Jun. 24, 2013, pp. A15677-A18127.
Appeal from the U.S. District Court for the Central District of California in No. 11-CV-9185, Judge Percy Anderson, May 9, 2014, pp. 1-48.
Civil Minutes—General: Case No. CV 11-9185PA (AJWx), *InTouch Tech., Inc.* v. *VGO Commons, Inc.*, Sep. 10, 2012, 7 pages.
Defendant VGO Communications, Inc.'s Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order, May 2, 2012, 143 pages.
Defendant-Counterclaimant VGO Communications, Inc.'s Supplemental Invalidity Contentions Pursuant to the Feb. 27, 2012 Civil Minute Order, May 14, 2012, 228 pages.
"Google translation of: Innovations Report", From research project to television star: Care-O-bot ZDF series, available online at <http://www.innovations-report.de/specials/printa.php?id=5157>, Sep. 28, 2001, 2 pages.
"Magne Charge", Smart Power to Electric Vehicles, Aug. 26, 1997, 2 pages.
"More Online Robots: Robots that Manipulate", available online at <http://ford.ieor.berkeley.edu/ir/robots_a2.html>, Retrieved on Nov. 23, 2010, Aug. 2001, 2 pages.
"MPEG File Format Summary", available online at <http://www.fileformat.info/format/mpeg/egff.htm>, Feb. 1, 2001, 8 pages.
"Nomad Scout Language Reference Manual", Nomadic Technologies, Software Version 2.7, part No. DOC00002, Jul. 12, 1999, 47 pages.
"Nomad Scout User's Manual", Nomadic Technologies, Software Version 2. 7, Part No. DOC00004, Jul. 12, 1999, pp. 1-59.
Opening Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Apr. 12, 2013, 187 pages.
PictureTel Adds New Features and Functionality to Its Award-Winning Live200 Desktop Videoconferencing System, PR Newswire Association, LLC, Gale, Cengage Learning, Jun. 13, 1997, 5 pages.
Reply Brief for Defendant-Appellee VGO Communications, Inc., Appeal from the U.S. District Court for the Central District of California, in Case No. 2:11-cv-9185, Judge Percy Anderson, May 28, 2013, 75 pages.
Reply Brief for Plaintiff-Appellant InTouch Technologies, Inc., Appeal from the U.S. District Court for the Central District of California in Case No. 11-cv-9185, Judge Percy Anderson, Jun. 14, 2013, 39 pages.
"ROBART I, II, III", Spawar, Systems Center Pacific, 1998, 8 pages.
Using your Infrared Cell Phone Camera, available online at <http://www.catsdomain.com/xray/about.htm>, Courtesy of Internet Wayback Machine, Jan. 30, 2010, 4 pages.
Celi et al., "The eICU: Its Not Just Telemedicine", Critical Care Medicine vol. 29, No. 8 (Supplement), Aug. 2001, pp. 183-189.
Cheetham et al., "Interface Development for a Child's Video Conferencing Robot", available online at <www.ryerson.ca/pebbles/publications/paper-iea200hfes-last.pdf>, 2000, 4 pages.
Christensen et al., "BeeSoft User's Guide and Reference", Robots for the Real World™, Real World Interface, Inc., Sep. 26, 1997, 203 pages.
Chu et al., "Detection of Target Mobile Signal Strength", Technical Development, Motorola Inc, Jan. 1999, pp. 205-206.
ACM Digital Library Record, "Autonomous Robots vol. 11 Issue 1", available online at <http://dl.acm.org/citation.cfm?id=591550&picked=prox&cfid=360891374&cftoken=35225929>, Jul. 2001, 2 pages.
Active Media, Inc., "Saphira Software Manual", Saphira Version 5.3, 1997, 105 pages.
Activmedia Robotics, "Pioneer 2/PeopleBot TM", Operations Manual , Version 9, Oct. 2001, 78 pages.
Adams, Chris, "Simulation of Adaptive Behavior (SAB'02)", Mobile Robotics Research Group, The Seventh International Conference, retrieved on Jan. 22, 2014, available online at <http://www.dai.ed.ac.uk/groups/mrg/MRG.html>, Aug. 4-11, 2002, 1 page.
Ando et al., "A Multimedia Self-service Terminal with Conferencing Functions", Robot and Human Communication, Tokyo, Proceedings of 4th IEEE International Workshop, Jul. 5-7, 1995, pp. 357-362.

(56) **References Cited**

OTHER PUBLICATIONS

Android Amusement Corp., "What Marketing Secret Renting Robots from Android Amusement Corp!", (Advertisement), 1982, 1 page.
Apple Inc., "I Phone", iPhone Series, XP002696350, Sep. 21, 2012, pp. 1-29.
Applebome, Peter, "Planning Domesticated Robots for Tomorrow's Household", New York Times, available online at <http://www.theoldrobots.com/images17/dc17.jpg>, Mar. 4,1982, pp. 21 and 23.
Bar-Cohen et al., "Virtual Reality Robotic Telesurgery Simulations Using MEMICA Haptic System", Proceedings of SPIE's 8th Annual International Symposium on Smart Structures and Materials, Mar. 5-8, 2001, pp. 1-7.
Barrett, Rick, "Video Conferencing Business Soars as Companies Cut Travel; Some Travel Cuts Are Permanent", available online at <http://www.ivci.com/international_videoconferencing_news_videoconferencing_news_19.html>, May 13, 2002, 2 pages.
Bartholomew, "Pharmacy Apothecary", available online at <http://classes.bnf.fr/ema/grands/034.htm>, retrieved on Jul. 26, 2012, 2 pages.
Bauer et al., "Remote Telesurgical Mentoring: Feasibility and Efficacy", IEEE, Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000, pp. 1-9.
Bauer, Jeffrey C., "Service Robots in Health Care: The Evolution of Mechanical Solutions to Human Resource Problems", Bon Secours Health System Inc., Technology Early Warning System(TEWS), Future of Service Robots in Health Care, Jun. 2003, pp. 1-10.
Bischoff, Rainer, "Design Concept and Realization of the Humanoid Service Robot HERMES", Field and Service Robotics, Springer, 1998, pp. 485-492.
Blackwell, Gerry, "Video: A Wireless LAN Killer App?", available online at <http://www.wi-fiplanet.com/columns/article.php/1010261/Video-A-Wireless-LAN-Killer>, Apr. 16, 2002, 4 pages.
Blaer et al., "TopBot: Automated Network Topology Detection With a Mobile Robot", IEEE, Proceedings of the 2003 International Conferences on Robotics 7 Automation, Taipei, Taiwan, Sep. 14-19, 2003, pp. 1582-1587.
Bradner, S., "The Internet Standards Process—Revision 3", Network Working Group, Request for Comments: 2026, BCP: 9, Obsoletes: 1602, Category: Best Current Practice, Oct. 1996, pp. 1-36.
Brenner, Pablo, "A technical tutorial on the IEEE 802.11 protocol", Breezecom Wireless Communications, 1997, pp. 1-24.
Breslow et al., "Effect of a Multiple-Site Intensive Care Unit Telemedicine Program on Clinical and Economic Outcome an Alternative Paradigm for Intensivist Staffing", Critical Care Med, vol. 32, No. 1, Jan. 2004, pp. 31-38.
Brooks, Rodney, "A Robust Layered Control System for a Mobile Robot", IEEE, Journal of Robotics and Automation, vol. 2, No. 1, Mar. 1986, pp. 14-23.
Brooks, Rodney Allen, "Remote Presence", Abstracts from Flesh & Machines, How Robots Will Change Us, Feb. 2002, pp. 131-147.
Yamasaki et al., "Applying Personal Robots and Active Interface to Video Conference Systems", 6th International Conference on Human Computer Interaction, vol. B, 1995, pp. 243-248.
Yamauchi, Brian, "PackBot: A Versatile Platform for Military Robotics", Proceedings of SPIE for Military Robotics, 2004, pp. 228-237.
Yong et al., "Robot Task Execution with Telepresence Using Virtual Reality Technology", 1998 International Conference on Mechatronic Technology, Nov. 30-Dec. 2, 1998, pp. 1-8.
Zambroski, James, "CMU, Pitt Developing 'Nursebot'", available online at <http://www.cs.cmu.edu/~nursebot/web/press/tribunereview.html>, Oct. 27, 2000, 3 pages.
Jouppi et al., "BiReality: Mutually-Immersive Telepresence", Proceedings of the 12th Annual ACM International Conference on Multimedia, Oct. 10-16, 2004, pp. 860-867.
Jouppi et al., "First Steps Towards Mutually-Immersive Mobile Telepresence", Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work, Nov. 16-20, 2002, pp. 354-363.
Kanehiro et al., "Virtual Humanoid Robot Plattorm to Develop Controllers of Real Humanoid Robots without Porting", IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 2, 2001, pp. 1093-1099.
Kaplan et al., "An Internet Accessible Telepresence", Multimedia Systems Journal, vol. 5, 1996, 7 pages.
Keller et al., "Raven Interface Project", The National Aviary's Teleconferencing Carnegie Mellon University Robot, Interaction and Visual Interface Design, School of Design, Carnegie Mellon University, 2001, 8 pages.
Khatib et al., "Robots in Human Environments", Proceedings International Conference on Control, Automation, Robotics, and Vision ICRACV2000, 1999, 15 pages.
Knight et al., "Active Visual Alignment of a Mobile Stereo Camera Platform", IEEE International Conference on Robotics and Automation, vol. 4, Apr. 24-28, 2000, pp. 3203-3208.
Koenen, Rob, "MPEG-4: a Powerful Standard for Use in Web and Television Environments", (KPN Research), available online at <http://www.w3.org/Architecture/1998/06/Workshop/paper26>, Jul. 1, 1998, 4 pages.
Kurlowicz et al., "The Mini Mental State Examination (MMSE)", Try This: Best Practices in Nursing Care to Older Adults, A series from the Hartford Institute of Geriatric Nursing, Issue No. 3, Jan. 1999, 2 pages.
Kuzuoka et al., "Can the GestureCam Be a Surrogate?", Proceedings of the Fourth European Conference on Computer-Supported Cooperative Work, 1995, pp. 181-196.
Lane, Earl, "Automated Aides", Available online at <http://www.cs.cum.edu/nursebot/web/press/nd4380.htm>, Oct. 17, 2000, 4 pages.
Lee et al., "A Novel Method of Surgical Instruction: International Telementoring", World Journal of Urology, vol. 16, No. 6, Dec. 1998, pp. 367-370.
Leifer et al."VIPRR: A Virtually in Person Rehabilitation Robot", Proceedings of 1997 International Conference on Rehabilitation Robotics, Apr. 14-15, 1997, 4 pages.
Lemaire, Edward, "Using Communication Technology to Enhance Rehabilitation Services: A Solution Oriented User Manual", Institute for Rehabilitation Research and Development, Terry Fox Mobile Clinic, The Rehabilitation Centre, Ottawa, Ontario, Canada, Version 2.0, available online at <http://www.irrd.ca/telehealth/distfile/distman_v2_1.pdf>, 1998-2001, 104 pages.
Library of Congress, "008- Fixed-Length Data Elements (NR)", MARC 21 Format for Classification Data, available online at <http://www.loc.gov/marc/classification/cd008.html>, Jan. 2000, pp. 1-14.
Lim et al., "Control to Realize Human-Like Walking of a Biped Humanoid Robot", IEEE International Conference on Systems, Man, and Cybernetics, 2000, vol. 5, 2000, pp. 3271-3276.
Linebarger et al., "Concurrency Control Mechanisms for Closely Coupled Collaboration in Multithreaded Virtual Environments", Department of Computer Science and Engineering, Lehigh University, vol. 13, 2004, 40 pages.
Long, William F., "Robot Navigation Technology", available online at <http://www.atp.nist.gov/eao/sp950-1/helpmate.htm>, Mar. 1999, 3 pages.
Luna, Nancy, "Robot a New Face on Geriatric Care", ocregister.Com, Aug. 6, 2003, 3 pages.
Mack, Michael J., "Minimally Invasive and Robotic Surgery", The Journal of the American Medical Association, vol. 285, No. 5, 2001, pp. 568-572.
Mair, G. M., "Telepresence—The Technology and its Economic and Social Implications", Technology and Society, 1997. 'Technology and Society at a Time of Sweeping Change'. Proceedings, 1997 International Symposium, Jun. 20-21, 1997, pp. 118-124.
Martin, Anya, "Brighter Days Ahead", Assisted Living Today, vol. 9, Nov./Dec. 2002, pp. 19-22.
McCardle et al., "The Challenge of Utilizing New Technology in Design Education", Loughborough University, IDATER 2000, 2000, pp. 122-127.

(56) **References Cited**

OTHER PUBLICATIONS

Meng et al., "E-Service Robot in Home Healthcare", Proceedings of the 2000 IEEE/RSJ, International Conference on Intelligent Robots and Systems, 2000, pp. 832-837.

Metz, Cade, "HP Labs", available online at <http://www.pcmag.com/article2/0,2817,1130820,00.asp>, Jul. 1, 2003, 4 pages.

Michaud, Anne, "Introducing "Nursebot"", available online at <http://www.cs.cmu.edu/nursebot/web/press/globe 301/index.html>, 2001, 4 pages.

Microsoft Corporation, Inc., "Microsoft NetMeeting 3 Features excerpt from Official Microsoft NetMeeting 3.0 Book", available online at <http://technet.microsoft.com/en-us/library/cc723477.aspx>, 2012, 6 pages.

Minsky, Marvin, "Telepresence", OMNI Magazine, Jun. 1980, 6 pages.

Montemerlo, Reddy Whittaker, "Telepresence: Experiments in Next Generation Internet", available online at <http://www.ri.cmu.edu/creative/archives.htm>, Oct. 20, 1998, 3 pages.

Murphy, Robin R., "Introduction to A1 Robotics", A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England, 2000, 487 pages.

Nakajima et al., "A Multimedia Teleteaching System using an Electronic Whiteboard for Two Way Communication of Motion Videos and Chalkboards", 2nd IEEE International Workshop on Robot and Human Communication, 1993, pp. 436-441.

Nakazato et al., "Group-Based Interface for Content-Based Image Retrieval", Proceedings of the Working Conference on Advanced Visual Interfaces, 2002, pp. 187-194.

Nakazato et al., "ImageGrouper: A Group-Oriented User Interface for Content-Based Image Retrieval and Digital Image Arrangement", Journal of Visual Languages & Computing, vol. 14, No. 4, Aug. 2003, pp. 45-46.

Nersc, "Berkeley Lab's RAGE Telepresence Robot Captures R&D100 Award", Available online at <https://www.nersc.gov/news-publications/news/nersc-center-news/2002/berkeley-lab-s-rage-telepresence-robot-captures-r-and-d100-award/>, Jul. 2, 2002, 2 pages.

Nomadic Technologies Inc., "Nomad XR4000 Hardware Manual", Release 1.0, Mar. 1999, 34 pages.

Noritsugu et al., "Application of Rubber Artificial Muscle Manipulator as a Rehabilitation Robot", Mechatronics, IEEE/ASME Transactions, vol. 2, No. 4, Dec. 1997, pp. 259-267.

North, Michael, "Telemedicine: Sample Script and Specifications for a Demonstration of Simple Medical Diagnosis and Treatment Using Live Two-Way Video on a Computer Network", Greenstar Corporation, 1998, 5 pages.

Ogata et al., "Development of Emotional Communication Robot: WAMOEBA-2R- Experimental Evaluation", Proceedings of the 2000 IEEE/RSJ International Conference on Intelligent Robots and Systems, vol. 1, 2000, pp. 175-180.

Ogata et al., "Emotional Communication Robot: WAMOEBA-2R—Emotion Model and Evaluation Experiments", Proceedings of the International Conference on Humanoid Robots, 2000, pp. 1-16.

Oh et al., "Autonomous Battery Recharging for Indoor Mobile Robots", Proceedings of Australian Conference on Robotics and Automation, 2000, pp. 1-6.

Ojha, Anand K., "An application of Virtual Reality in Rehabilitation", Proceedings of the 1994 IEEE Southeastcon 94. Creative Technology Transfer—A Global Affair, Apr. 1994, pp. 4-6.

Osborn, Jim, "Quality of Life Technology Center", QoLT Research Overview: A National Science Foundation Engineering Research Center, Carnegie Mellon University of Pittsburgh, 2 pages.

Panusopone et al., "Performance comparison of MPEG-4 and H.263+ for streaming video applications", Circuits Systems Signal Processing, vol. 20, No. 3, 2001, pp. 293-309.

Paulos et al., "A World Wide Web Telerobotic Remote Environment Browser", Available online at <http://www.w3.org/Conferences/WWW4/Papers/326/>, 1995, 15 pages.

Paulos et al., "Designing Personal Tele-Embodiment", Proceedings of IEEE International Conference on Robotics and Automation, vol. 4, May 16-20, 1998, pp. 3173-3178.

Paulos, Eric J., "Personal Tele-Embodiment", Dissertation, Doctor of Philosophy in Computer Science in the Graduate Division of the University of California at Berkeley, 2001, 282 pages.

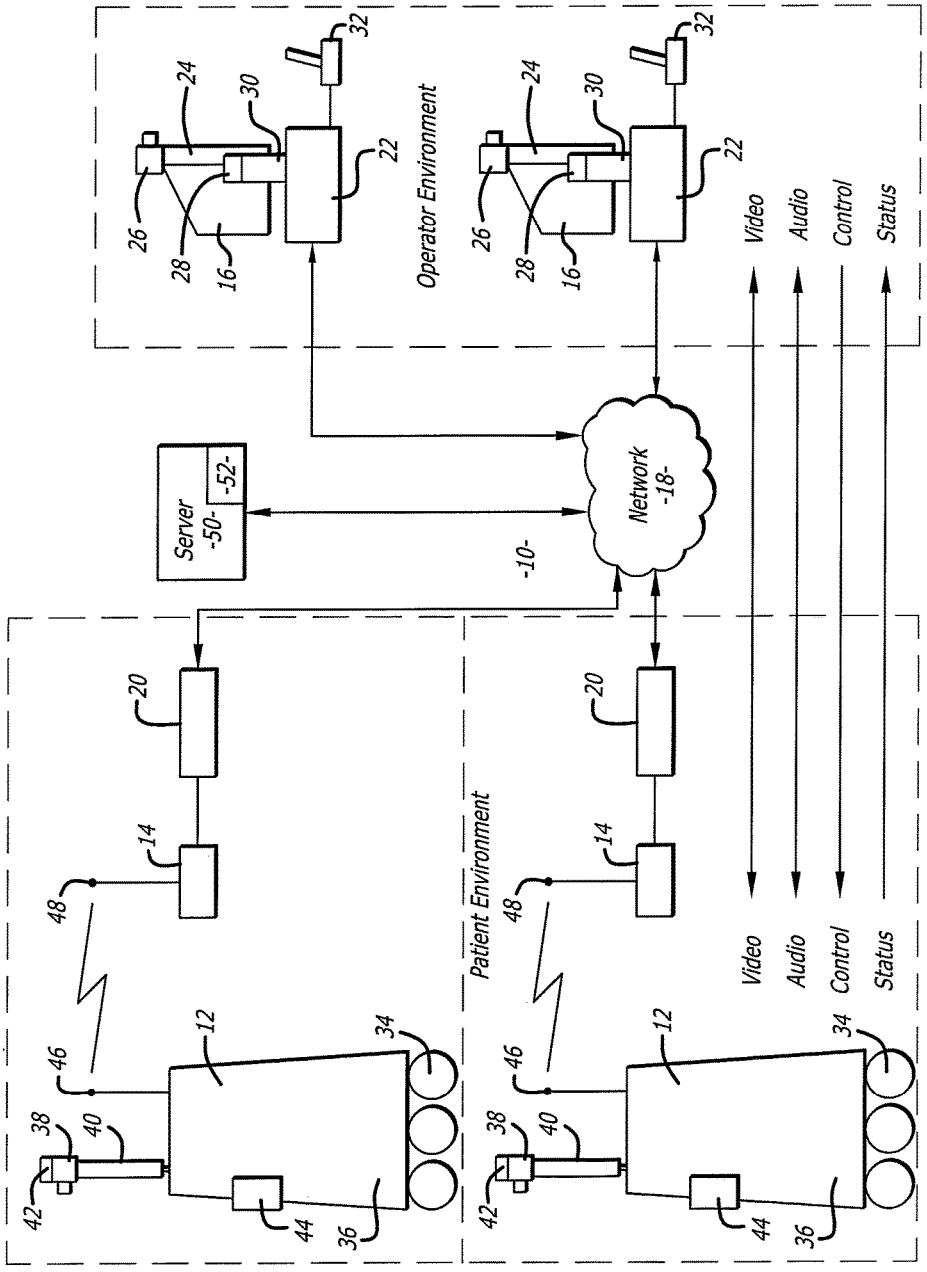
Paulos, Eric John, "Personal Tele-Embodiment", OskiCat Catalog Record, UCB Library Catalog, 2001, 3 pages.

Paulos et al., "Personal Tele-Embodiment", Chapter 9 in Goldberg, et al., ed. "Beyond webcams", MIT Press, Jan. 4, 2002, pp. 155-167.

Paulos, Eric John, "Personal Tele-Embodiment", Introductory and cover pages from 2001 Dissertation including Contents table, together with e-mails relating thereto from UC Berkeley Libraries, as shelved at UC Berkeley Engineering Library (Northern Regional library Facility), May 8, 2002, 25 pages (including 4 pages of e-mails).

Paulos et al "PRoP: Personal Roving Presence", ACM:CHI Proceedings of CHI '98, 1998, 8 pages.

* cited by examiner


Operator Environment
Patient Environment
Server
-50-
-52-
Network
-18-
-10-
Video
Audio
Control
Status
16
20
22
24
26
28
30
32
34
36
38
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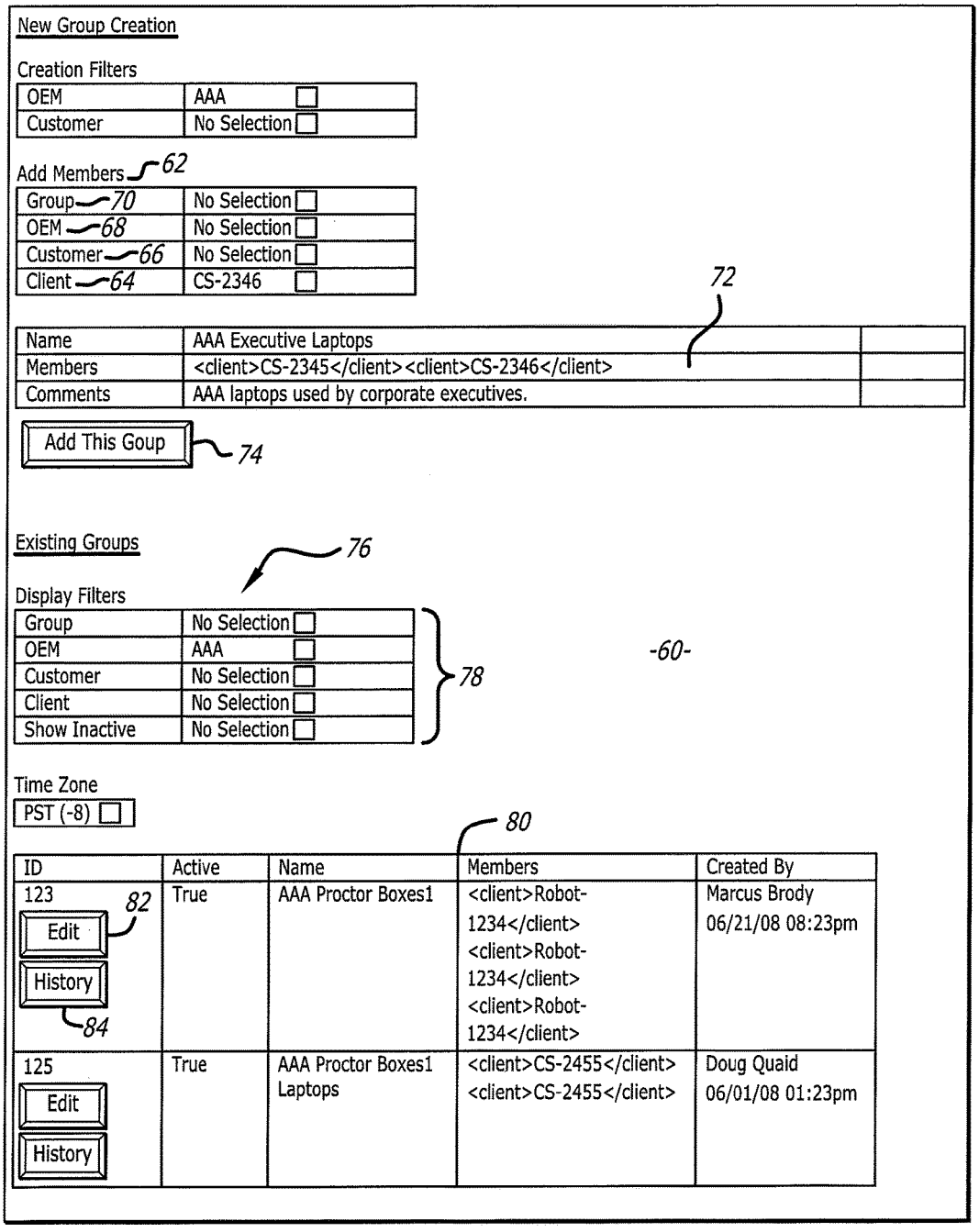
42
44
46
48

FIG. 1


New Group Creation
Creation Filters
OEM
AAA
Customer
No Selection
Add Members
62
Group
70
No Selection
OEM
68
No Selection
Customer
66
No Selection
Client
64
CS-2346
72
Name
AAA Executive Laptops
Members
<client>CS-2345</client><client>CS-2346</client>
Comments
AAA laptops used by corporate executives.
Add This Goup
74
Existing Groups
76
Display Filters
Group
No Selection
OEM
AAA
Customer
No Selection
Client
No Selection
Show Inactive
No Selection
78
-60-
Time Zone
PST (-8)
80
ID
Active
Name
Members
Created By
123
82
Edit
History
84
True
AAA Proctor Boxes1
<client>Robot-1234</client> <client>Robot-1234</client> <client>Robot-1234</client>
Marcus Brody 06/21/08 08:23pm
125
Edit
History
True
AAA Proctor Boxes1 Laptops
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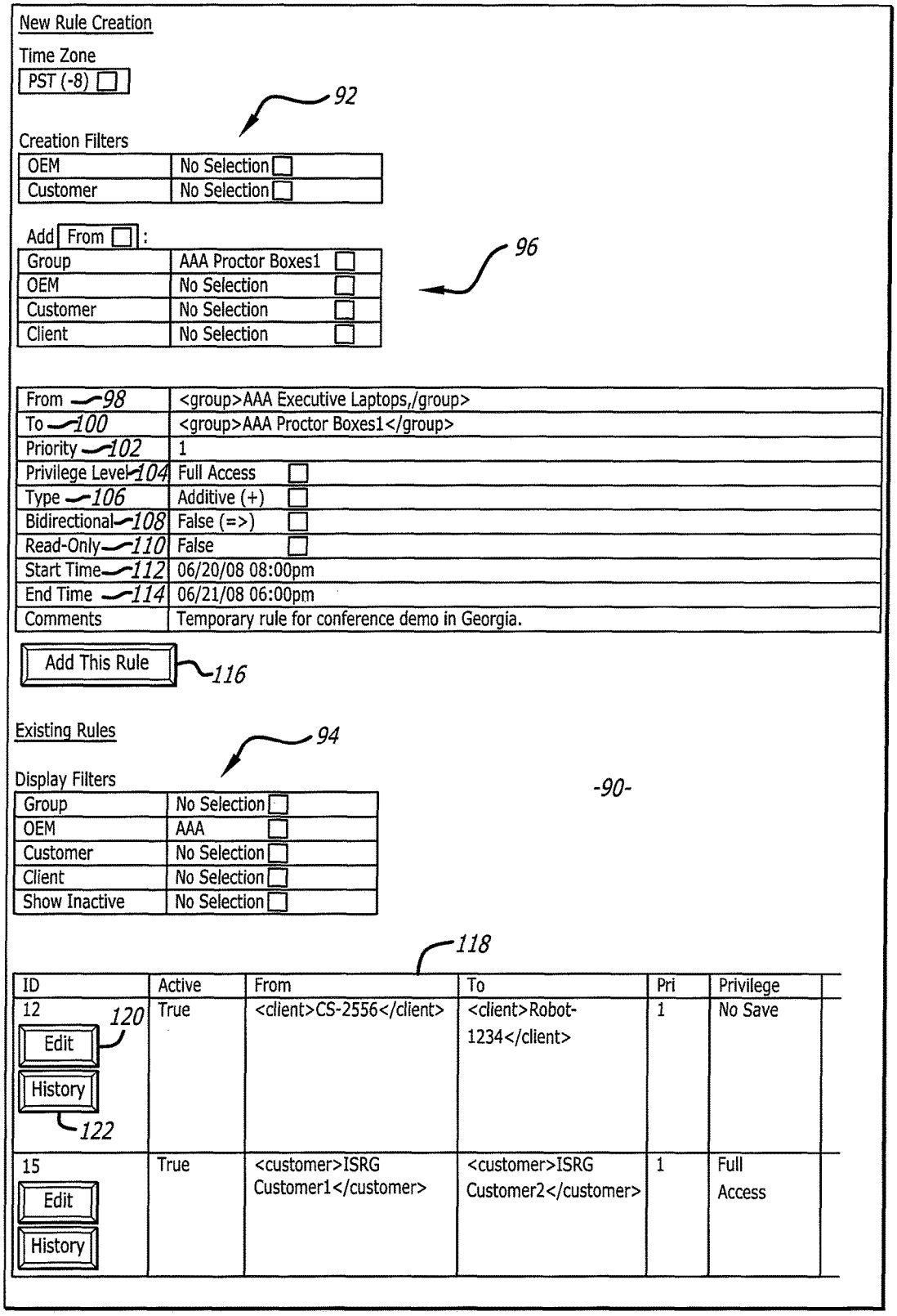
Doug Quaid 06/01/08 01:23pm

FIG. 2

FIG. 3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Time Zone
PST (-8)
92
Creation Filters
OEM
No Selection
Customer
No Selection
Add From :
96
Group
AAA Proctor Boxes1
OEM
No Selection
Customer
No Selection
Client
No Selection
From 98
<group>AAA Executive Laptops,/group>
To 100
<group>AAA Proctor Boxes1</group>
Priority 102
1
Privilege Level 104
Full Access
Type 106
Additive (+)
Bidirectional 108
False (=>)
Read-Only 110
False
Start Time 112
06/20/08 08:00pm
End Time 114
06/21/08 06:00pm
Comments
Temporary rule for conference demo in Georgia.
Add This Rule
116
Existing Rules
94
Display Filters
Group
No Selection
OEM
AAA
Customer
No Selection
Client
No Selection
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No Selection
-90-
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Pri
Privilege
12
120
Edit
History
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1
Full Access

FIG. 4

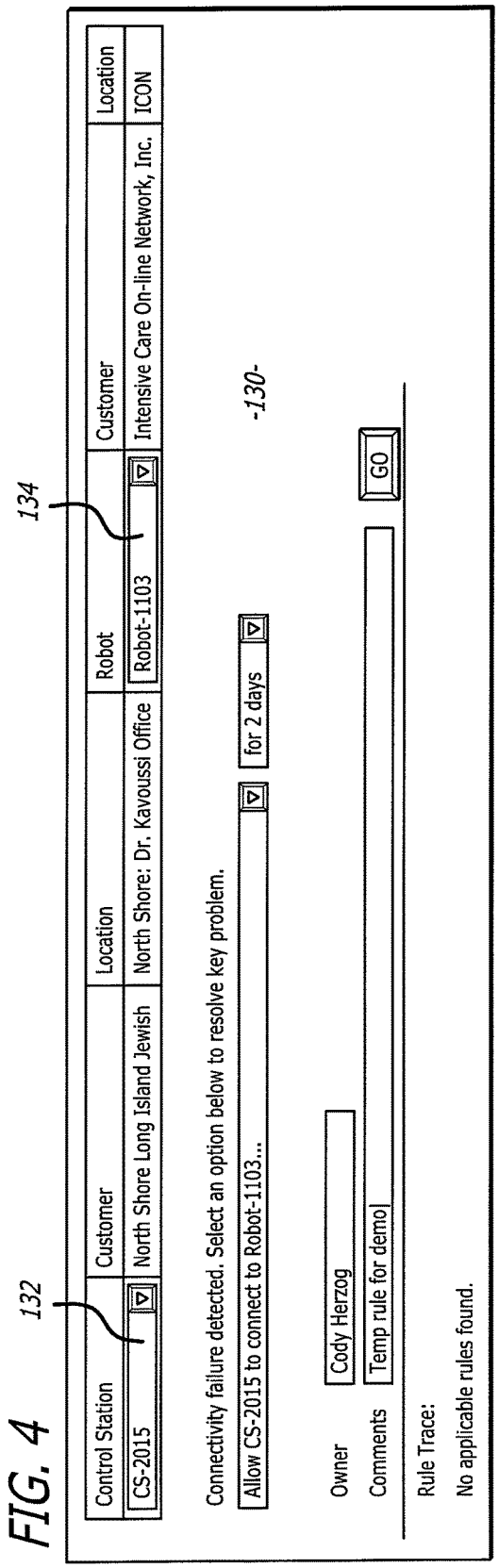
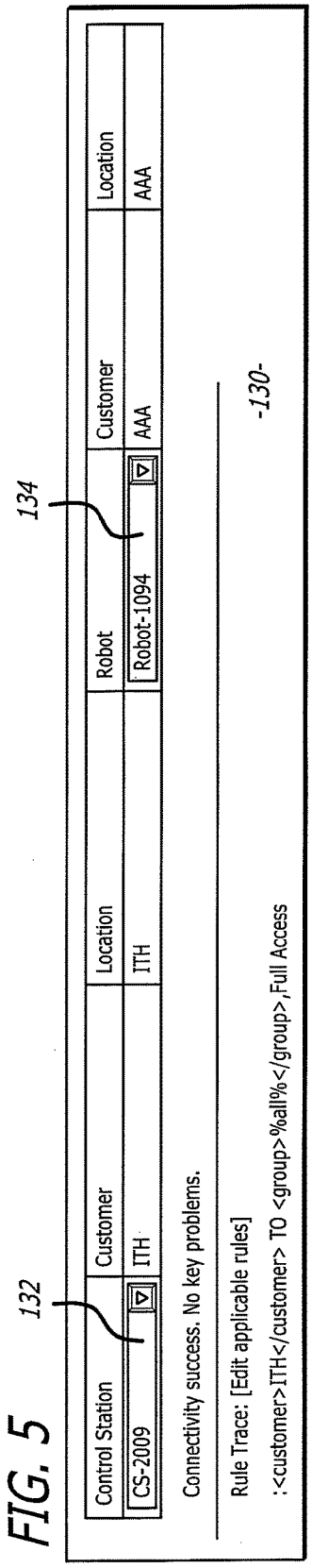

132
134
Control Station
Customer
Location
Robot
Customer
Location
CS-2015
North Shore Long Island Jewish
North Shore: Dr. Kavoussi Office
Robot-1103
Intensive Care On-line Network, Inc.
ICON
Connectivity failure detected. Select an option below to resolve key problem.
-130-
Allow CS-2015 to connect to Robot-1103...
for 2 days
Owner
Cody Herzog
Comments
Temp rule for demo
GO
Rule Trace:
No applicable rules found.

FIG. 5


132
134
Control Station
Customer
Location
Robot
Customer
Location
CS-2009
ITH
ITH
Robot-1094
AAA
AAA
Connectivity success. No key problems.
-130-
Rule Trace: [Edit applicable rules]
:<customer>ITH</customer> TO <group>%all%</group>,Full Access

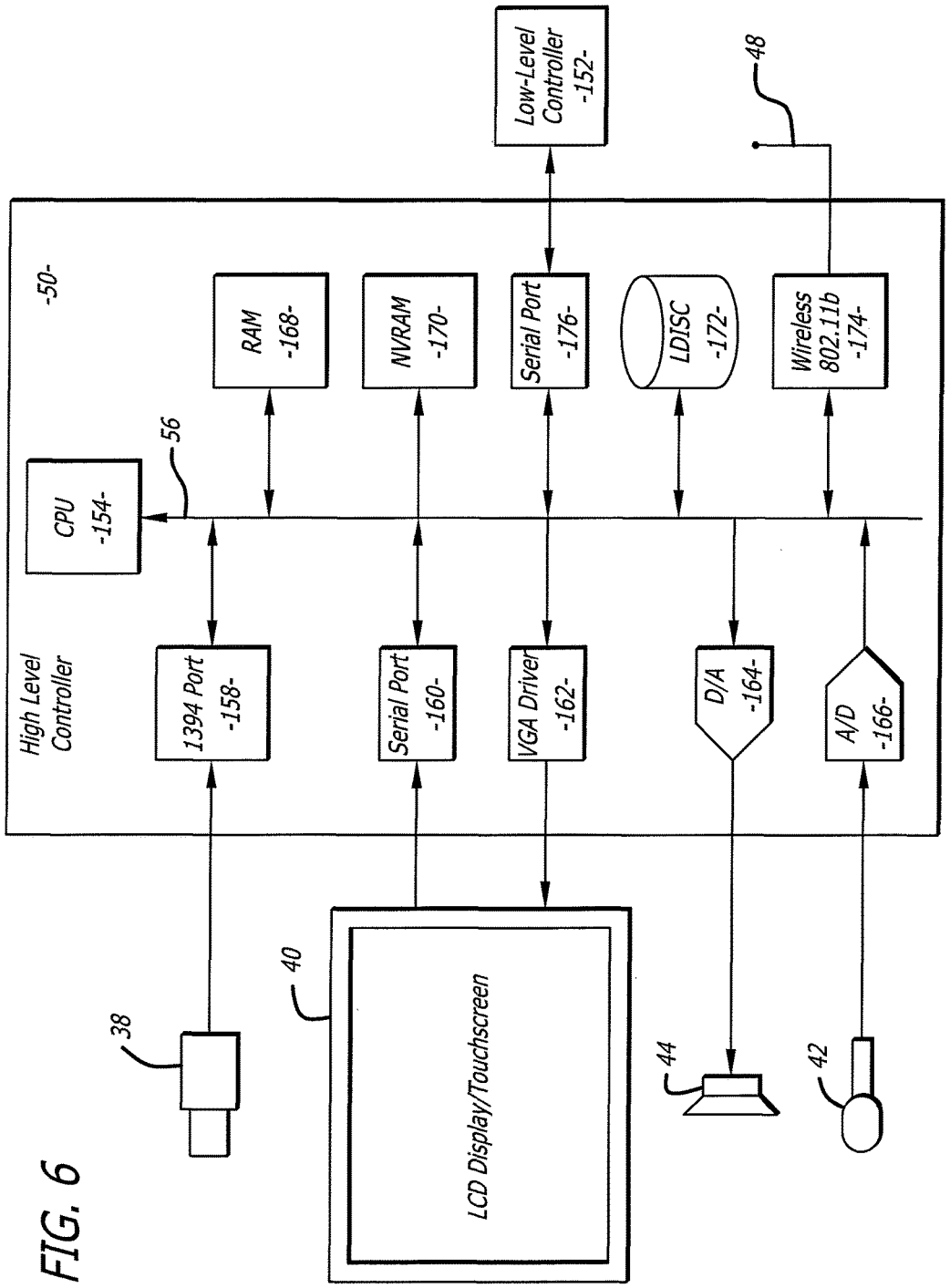

Low-Level Controller -152-
48
-50-
RAM -168-
NVRAM -170-
Serial Port -176-
LDISC -172-
Wireless 802.11b -174-
56
CPU -154-
High Level Controller
1394 Port -158-
Serial Port -160-
VGA Driver -162-
D/A -164-
A/D -166-
38
40
LCD Display/Touchscreen
44
42

FIG. 6

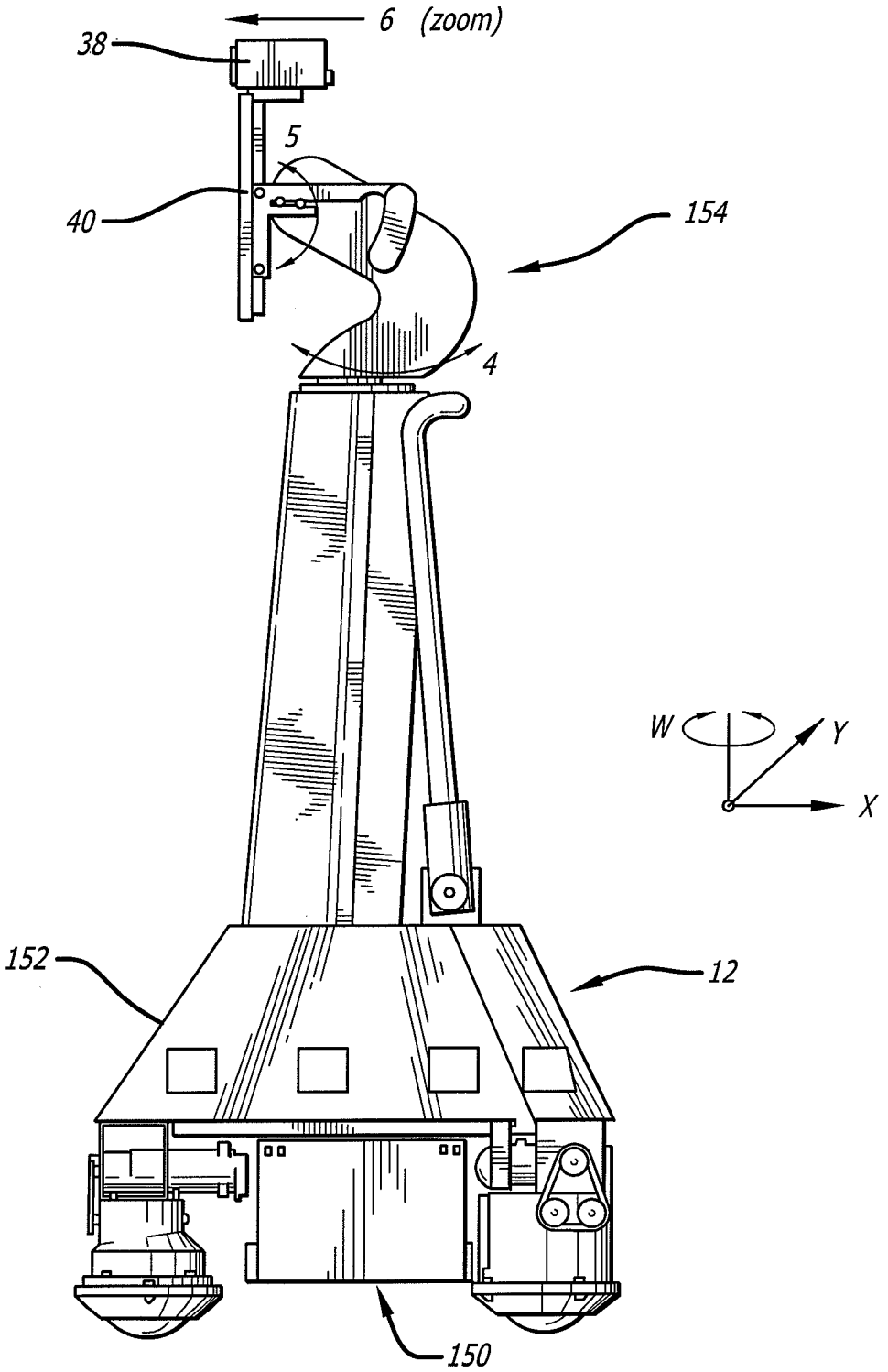
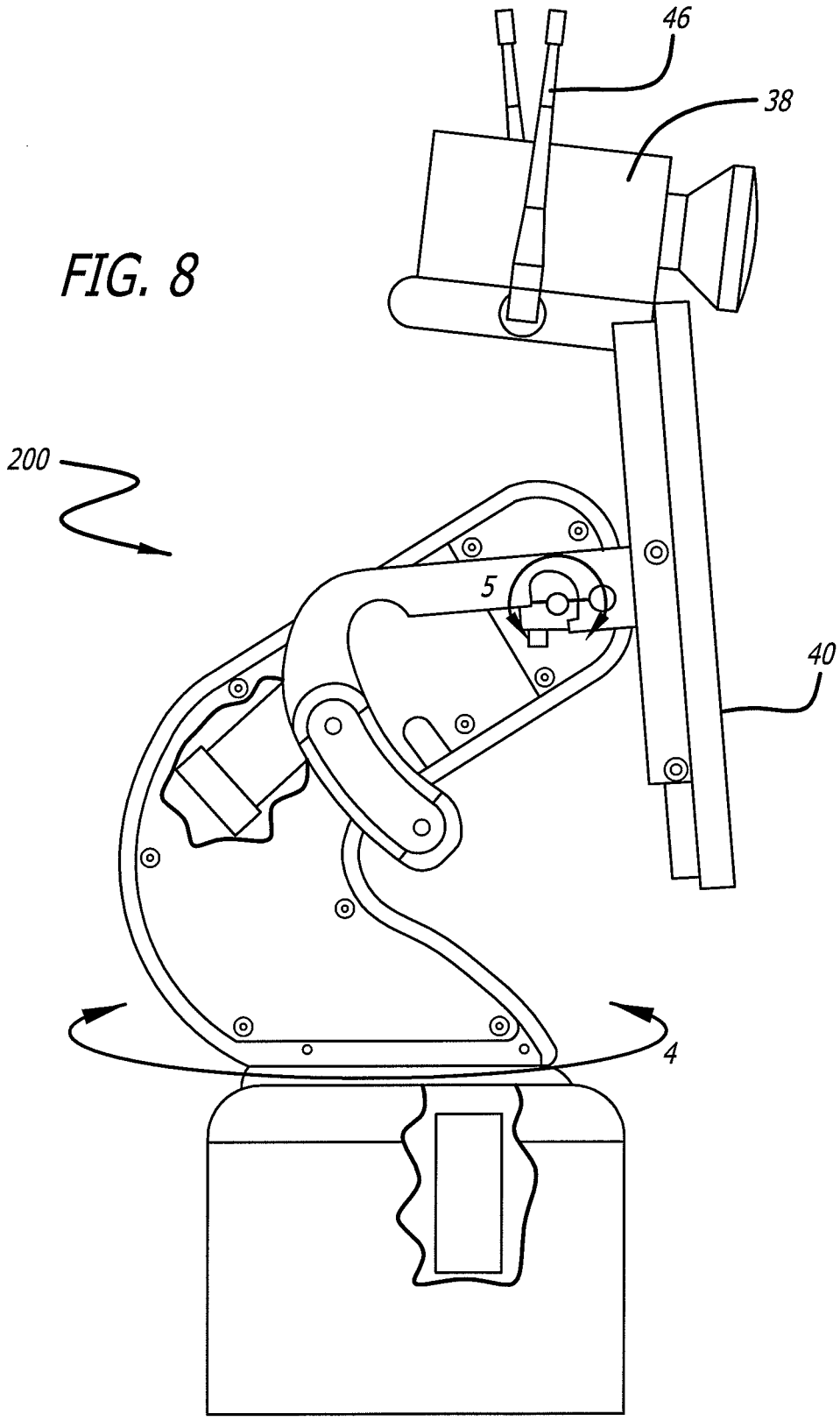


FIG. 7

FIG. 8



SERVER CONNECTIVITY CONTROL FOR A TELE-PRESENCE ROBOT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The subject matter disclosed generally relates to the field of robotics.

2. Background Information

Robots have been used in a variety of applications ranging from remote control of hazardous material to assisting in the performance of surgery. For example, U.S. Pat. No. 5,762,458 issued to Wang et al. discloses a system that allows a surgeon to perform minimally invasive medical procedures through the use of robotically controlled instruments. One of the robotic arms in the Wang system moves an endoscope that has a camera. The camera allows a surgeon to view a surgical area of a patient.

There has been marketed a tele-presence mobile robot introduced by InTouch Technologies, Inc., the assignee of this application, under the trademark RP-7. The InTouch robot is controlled by a user at a remote station. The remote station may be a personal computer with a joystick that allows the user to remotely control the movement of the robot. Both the robot and remote station have cameras, monitors, speakers and microphones to allow for two-way video/audio communication. The robot camera provides video images to a screen at the remote station so that the user can view the robot's surroundings and move the robot accordingly.

The InTouch robot system can be used to access any number of robots from different remote locations. For example, a hospital facility may have a number of tele-presence robots that are accessible from different remote computer stations. A physician can become connected to a robot by merely logging on through a laptop or personal computer. As the number of in-field InTouch tele-presence robots grows, it is desirable to set and edit the connectivity between various remote control stations and different robots. It is also desirable to provide a means to control the parameters of the connectivity. For example, it may be desirable to control connectivity so that multiple remote control stations can receive the audio/video provided by the robot. It may be desirable to restrict the audio and/or video provided to one or more remote control stations. It may also be desirable to establish a time window of connectivity between control stations and robots.

BRIEF SUMMARY OF THE INVENTION

A robot system with a robot that has a camera and a remote control station that can connect to the robot. The connection can include a plurality of privileges. The system further includes a server that controls which privileges are provided to the remote control station. The system may include a manager control station that can access said server to establish and edit said privileges.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a robotic system;

FIG. **2** is an illustration of a user interface to create connectivity groups;

FIG. **3** is an illustration of a user interface to create connectivity rules;

FIG. **4** is an illustration of a user interface used to test connectivity between a remote control station and a robot;

FIG. **5** is an illustration of a user interface similar to FIG. **4** showing an error message;

FIG. **6** is a schematic of an electrical system of a robot;

FIG. **7** is side view of the robot;

FIG. **8** is a side view of a robot head.

DETAILED DESCRIPTION

Disclosed is a robot system with a robot that has a camera and a remote control station that can connect to the robot. The connection can include a plurality of privileges. The system further includes a server that controls which privileges are provided to the remote control station. The privileges may include the ability to control the robot, join in a multi-cast session and the reception of audio/video from the robot. The privileges can be established and edited through a manager control station.

The server may contain a database that defines groups of remote control stations that can be connected to groups of robots. The database can be edited to vary the stations and robots within a group. The system may also allow for connectivity between a remote control station and a robot within a user programmable time window. The system may also allow for connectivity between arbitrary endpoints, including control station to control station connections and robot to robot connections.

Referring to the drawings more particularly by reference numbers, FIG. **1** shows an embodiment of a robot system **10**. The robot system **10** includes a plurality of robots **12** each with a base station **14** and a plurality of remote control stations **16**. Each remote control station **16** may be coupled to the base station **14** through a network **18**. By way of example, the network **18** may be either a packet switched network such as the Internet, or a circuit switched network such has a Public Switched Telephone Network (PSTN) or other broadband system. The base station **14** may be coupled to the network **18** by a modem **20** or other broadband network interface device.

Each remote control station **16** may include a computer **22** that has a monitor **24**, a camera **26**, a microphone **28** and a speaker **30**. The computer **22** may also contain an input device **32** such as a joystick or a mouse. Each control station **16** is typically located in a place that is remote from the robot **12**. Although only one robot **12** is shown, it is to be understood that the system **10** may have a plurality of robots **12**. In general any number of robots **12** may be controlled by any number of remote stations. For example, one remote station **16** may be coupled to a plurality of robots **12**, or one robot **12** may be coupled to a plurality of remote stations **16**.

The robot **12** includes a movement platform **34** that is attached to a robot housing **36**. Also attached to the robot housing **36** are a camera **38**, a monitor **40**, a microphone(s) **42** and a speaker **44**. The microphone **42** and speaker **30** may create a stereophonic sound. The robot **12** may also have an antenna **46** that is wirelessly coupled to an antenna **48** of the base station **14**. The system **10** allows a user at the remote control station **16** to move the robot **12** through the input device **32**. The robot camera **38** is coupled to the remote monitor **24** so that a user at the remote station **16** can view a patient. Likewise, the robot monitor **40** is coupled to the remote camera **26** so that the patient can view the user. The microphones **28** and **42**, and speakers **30** and **44**, allow for audible communication between the patient and the user.

Each remote station computer **22** may operate Microsoft OS software and WINDOWS XP or other operating systems such as LINUX. The remote computer **22** may also operate a video driver, a camera driver, an audio driver and a joystick

driver. The video images may be transmitted and received with compression software such as MPEG CODEC. The control station may have general user interfaces that allow for operation of a robot and for multi-casting with other remote stations.

The system **10** includes a server **50** that controls connectivity between the remote control stations **16** and the robots **12**. The server **50** includes a database **52**. By way of example, the database **52** may be a relational database. The database **52** can allow for groups of remote stations to connect groups of robots. Groups may contain individual robots and control stations. Groups may also contain customers, which represent all robots and control stations belonging to a particular customer. Groups may also contain OEM configurations, which represent all robots and control stations that are sold by a particular 3rd-party OEM distributor. Groups may also contain other groups in a recursive fashion. By way of example, one healthcare entity may have three robots designated ROBOT-1, ROBOT-2 and ROBOT-3 and 5 remote stations designated CS-1, CS-2, CS-3, CS-4 and CS-5. The 3 robots are defined as group R and the remote stations are defined as group S. Rules can be established that allow connectivity between any remote station in group S with any robot in group R.

FIG. **2** shows a user interface **60** that can be used to create and edit groups. The interface includes an "Add Members" field **62** that allows a user to add members to a group. The members can be selected through the "Clients" field **64**, "Customers" field **66**, "OEM" configuration field **68** or by a "Group" name field **70**. The members of the new group are listed in the "Members" field **72**. The members can be listed as a string of client serial numbers, customer ids, OEM configuration ids and group ids in a simple XML-like format. In this example, the group includes client control stations CS-2345 and CS-2346. The interface **60** may include an "Add This Group" button **74** that can be selected to add a group to the database.

The interface **60** may include an "Existing Groups" area **76** that allows the user to view existing groups and group members through fields **78** which filter based on the category of group name, OEM, customer or client. Interface area **80** lists each group along with the group members, the person who created the group (with time log), and an indication of whether the group is active. An existing group can be edited by selecting an "Edit" button **82**. A history of edits can be viewed by selecting the "History" button **84**.

The group data may be stored in the database with the following group connectivity information:

id [int, identity]: Unique numeric ID.

createID [int]: ID that is shared amongst all group edits in the history chain. This is used to locate the group history. For the initial group creation, the createID is equal to the regular id. All subsequent edits to the group will retain the same createID, but will be given new unique regular ids.

isActive[bit]: Set to true if group is currently considered active, meaning that it has not been edited and replaced by a new version of the group.

name [nvarchar]: Friendly name of group. This name appears in any group dropdowns in an advanced page.

members [text]: String of group members. Contains mixed client machines, customer names, OEM configurations and nested groups.

membersExpanded [text]: Stores members in an expanded format where all nested groups and OEMs are expanded to list all client machines and customers contained in the groups.

createdUTC[int]: Timestamp of initial group creation in UTC seconds. When a group is edited, the original group becomes inactive and a new group is created, but the createdUTC timestamp is maintained in the new group.

modifiedUTC[int]: Timestamp of most recent group modification in UTC seconds. For groups being made inactive due to a group edit, the newly inactive group will have its modified timestamp set to the time of the edit.

creator[nvarchar]: The user who first created the group. This can be automatically pulled from domain login credentials used to access the various UI pages.

lastModifiedBy[nvarchar]: The user who last modified the group. This can be automatically pulled from domain login credentials used to access the various UI pages.

comments[text]: Textual comments attached to group.

FIG. **3** is an interface **90** that can be used to create and edit connectivity rules. The interface **90** includes rule creation filter fields **92** that allow a user to filter the list of systems that appear in the client field when creating new rules. There are also fields **94** that allow the user to review existing rules. The connectivity path of a rule can be defined in fields **96** by adding groups, OEMs, customers, and individual robots and control stations to the "From" **98** and "To" **100** fields.

The rules include "From" **98** and "To" **100** fields that define the connectivity path between control stations and robots. The "Priority" field **102** defines how conflicting rules will be resolved. When rules are in conflict, the priority value resolves the ambiguity. If two conflicting rules have the same priority, the rule that was modified most recently wins. The "Privilege Level" field **104** establishes what privileges are allowed in this particular connectivity. By way of example, the system may allow the following privileges:

The ability to operate the robot.

The ability to accept multi-cast sessions with one or more other remote control stations.

The ability to be the Host (primary control station CS user) for a multi-cast session with one or more other remote control stations.

The ability to be a Guest CS in a multi-cast session with one or more other remote control stations.

The ability to connect directly to a robot (i.e. without being a Guest).

Disabling of all visible video output and/or audio output on a Guests system of what is captured on the robot.

Disabling video output and/or audio output on the robot of what is captured on one or more Guest control stations.

Disabling of saving of media including snapshots and movies from the robot.

Access to a medical device connected to the robot.

The ability to view and control auxiliary video sources.

The ability to use an external handset attached to the robot.

The "Type" field **106** allows the user to specify whether the rule is additive or subtractive. Additive rules can be used to add connectivity. Subtractive rules can be used to selectively remove connectivity in a targeted manner. In this fashion, if one defines the connectivity to or from a group, and then subtracts connectivity privileges of a sub-group, and further adds connectivity privileges of a sub-sub-group, the system thereby allows one to define a hierarchy of connectivity rules The "Bidirectional" field **108** allows for connectivity between the From and To members to be unidirectional ("False") or bidirectional ("True") which is selectable by the user. The user can set the rule as read-only in the "Read-Only" field **110**. Read-only rules always appear

at the top of the list when rules are displayed. They require special double confirmation to be edited or deleted.

The user can select a time window for connectivity by entering a start date and time in a "Start Time" field **112** and an end date and time in an "End Time" field **114**. The rule can be added by selecting the "Add This Rule" button **116**. This allows a user to schedule connectivity in advance, to be enabled at a later date and time.

The From, To, Priority, Privilege and Active data for existing rules can be displayed in an interface area **118**. A user can edit an existing rule by selecting an "Edit" button **120** and review edit history by selecting a "History" button **122**.

The rules can be stored in the relational database with the following connectivity rule information:

id [int, identity]: Unique numeric ID.

createID [int]: ID that is shared amongst all rules in the history chain that resulted from edits. This is used to locate the rule history. For the initial rule, the createID is equal to the regular id. All subsequent edits to the rule will retain the same createID, but will be given new unique regular ids.

priority [int]: Allows establishing precedence between conflicting rules by determining the order in which rules are applied. Higher numbers means the rule will be applied later in the logic chain.

groupFrom [text]: String of "from" group members. Contains mixed client machines, customers and groups. For non-bidirectional rules, this represents the source of connectivity, for bidirectional rules it represents both source and destination.

groupTo [text]: String of "to" group members. Contains mixed client machines, customers and groups. For non-bidirectional rules, this represents the destination of connectivity, for bidirectional rules it represents both source and destination.

groupFromExpanded [text]: Stores groupFrom in an expanded format where all nested groups and OEMs are expanded to list all client machines and customers contained in the groups.

groupToExpanded [text]: Stores groupTo in an expanded format where all nested groups and OEMs are expanded to list all client machines and customers contained in the groups.

privilegeMaskFriendlyNameID [int]: Sets the privilege mask associated with this connectivity rule. This is a link to a privilege table. This can also be set to the special value of −1, which implies that the privilege is not explicitly defined and will be inherited from a rule that is higher up in the logic chain. The privilege table can be transferred to a control station which includes code that can decode the table to determine which privileges are allowed in a connectivity.

isActive[bit]: Set to true if rule is currently considered active, meaning that it has not expired and has not explicitly been removed or deactivated as the result of being replaced by a new version of the rule following an edit.

isBidirectional[bit]: Set to true if rule is bidirectional, meaning that "from" can connect to "to" and vice versa. Set to false for one-way, "from"→"to" connectivity.

isReadOnly[bit]: Set to true if the rule is read only, meaning that it requires double confirmation on edit/delete and always appears at top of rule list display. Set to false for standard rule.

type[int]: 0=additive connectivity rule, 1=subtractive connectivity rule, 2=privilege-only rule

startUTC[int]: Defines the start of time window that rule is active in UTC seconds.

endUTC[int]: Defines the end of time window that rule is active in UTC seconds. For infinite rules, this will be set to 0.

createdUTC[int]: Timestamp of initial rule creation in UTC seconds. When a rule is edited, the original rule becomes inactive and a new rule is created, but the createdUTC timestamp is maintained in the new rule.

modifiedUTC[int]: Timestamp of most recent rule modification in UTC seconds. For rules being made inactive due to a rule edit, the newly inactive rule will have its modified timestamp set to the time of the edit.

creator[nvarchar]: The user who first created the rule. This can be automatically pulled from domain login credentials used to access the various UI pages.

lastModifiedBy[nvarchar]: The user who last modified the rule. This can be automatically pulled from domain login credentials used to access the various UI pages.

comments[text]: Textual comments attached to rule. These are required.

The ability to change/add groups and rules can be limited to a select field of users, requiring a password/code for access to the interfaces **60** and **90**. The server **50** may provide interfaces that can be accessed by the remote control stations **16** to review connectivity. The pages can provide information on which robots can be accessed by a particular remote control station or which remote control stations can access a specific robot.

The server may provide a tester page that allows a user to test the connectivity between two endpoints. FIG. **4** shows an interface **130** that can be used to test connectivity. The interface **130** includes a "Control Station" field **132** that allows a user to enter a control station name and a "Robot" field **134** that allows the user to enter a robot name. If connectivity is allowed by the server **50** then the interface may indicate a successful connection as in FIG. **5**. If connectivity is not allowed by the server **50** then the interface may display a message as shown in FIG. **4**. In either case, the interface may display the list of all connectivity rules that applied to the calculation of the connectivity success or failure.

A manager control station is defined as any computer which has access to one or more of the interfaces depicted in FIGS. **2** and **5**. For example, any office computer, including a remote control station itself, can be navigated to a secure web page through a browser such as Internet Explorer, and, after supplying credentials, access those interfaces.

FIG. **6** shows an embodiment of the robot **12**. The robot **12** may include a high level control system **150** and a low level control system **152**. The high level control system **150** may include a processor **154** that is connected to a bus **156**. The bus is coupled to the camera **138** by an input/output (I/O) port **158**, and to the monitor **140** by a serial output port **160** and a VGA driver **162**. The monitor **40** may include a touchscreen function that allows the patient to enter input by touching the monitor screen.

The speaker **44** is coupled to the bus **156** by a digital to analog converter **164**. The microphone **42** is coupled to the bus **156** by an analog to digital converter **166**. The high level controller **150** may also contain random access memory (RAM) device **168**, a non-volatile RAM device **170** and a mass storage device **172** that are all coupled to the bus **162**. The mass storage device **172** may contain medical files of the patient that can be accessed by the user at the remote control station **16**. For example, the mass storage device **172**

may contain a picture of the patient. The user, particularly a health care provider, can recall the old picture and make a side by side comparison on the monitor **24** with a present video image of the patient provided by the camera **38**. The robot antennae **46** may be coupled to a wireless transceiver **174**. By way of example, the transceiver **174** may transmit and receive information in accordance with IEEE 802.11b.

The controller **154** may operate with a LINUX OS operating system. The controller **154** may also operate MS WINDOWS along with video, camera and audio drivers for communication with the remote control station **16**. Video information may be transceived using MPEG CODEC compression techniques. The software may allow the user to send e-mail to the patient and vice versa, or allow the patient to access the Internet. In general the high level controller **150** operates to control the communication between the robot **12** and the remote control station **16**. The controller and the high level controller **150** may be linked to the low level controller **152** by serial ports **176**.

The low level controller **152** runs software routines that mechanically actuate the robot **12**. For example, the low level controller **152** provides instructions to actuate the movement platform to move the robot **12**. The low level controller **152** may receive movement instructions from the high level controller **150**. The movement instructions may be received as movement commands from the remote control station. Although two controllers are shown, it is to be understood that the robot **12** may have one controller controlling the high and low level functions.

FIG. **7** shows an embodiment of the robot **12**. The robot **12** may include a holonomic platform **150** that is attached to a robot housing **152**. The holonomic platform **150** provides three degrees of freedom to allow the robot **12** to move in any direction.

The robot **12** may have a head **154** that supports the camera **38** and the monitor **40**. The head **154** may have two degrees of freedom so that the camera **26** and monitor **24** can be swiveled and pivoted as indicated by the arrows.

The system may be the same or similar to a robotic system provided by the assignee InTouch-Health, Inc. of Santa Barbara, Calif. under the trademark RP-7. The system may also be the same or similar to the system disclosed in U.S. Pat. No. 6,925,357 issued Aug. 2, 2005, which is hereby incorporated by reference.

In operation, the robot **12** may be placed in a home, public or commercial property, or a facility where one or more patients are to be monitored and/or assisted. The facility may be a hospital or a residential care facility. By way of example, the robot **12** may be placed in a home where a health care provider may monitor and/or assist the patient. Likewise, a friend or family member may communicate with the patient. The cameras and monitors at both the robot and remote control stations allow for teleconferencing between the patient and the person at the remote station(s).

The robot **12** can be maneuvered through the home, property or facility by manipulating the input device **32** at a remote station **16**.

The robot **10** may be controlled by a number of different users. To accommodate for this the robot may have an arbitration system. The arbitration system may be integrated into the operating system of the robot **12**. For example, the arbitration technique may be embedded into the operating system of the high-level controller **150**.

By way of example, the users may be divided into classes that include the robot itself, a local user, a caregiver, a doctor, a family member, or a service provider. The robot **12** may override input commands that conflict with robot operation. For example, if the robot runs into a wall, the system may ignore all additional commands to continue in the direction of the wall. A local user is a person who is physically present with the robot. The robot could have an input device that allows local operation. For example, the robot may incorporate a voice recognition system that receives and interprets audible commands.

A caregiver is someone who remotely monitors the patient. A doctor is a medical professional who can remotely control the robot and also access medical files contained in the robot memory. The family and service users remotely access the robot. The service user may service the system such as by upgrading software, or setting operational parameters.

Message packets may be transmitted between a robot **12** and a remote station **16**. The packets provide commands and feedback. Each packet may have multiple fields. By way of example, a packet may include an ID field a forward speed field, an angular speed field, a stop field, a bumper field, a sensor range field, a configuration field, a text field and a debug field.

The identification of remote users can be set in an ID field of the information that is transmitted from the remote control station **16** to the robot **12**. For example, a user may enter a user ID into a setup table in the application software run by the remote control station **16**. The user ID is then sent with each message transmitted to the robot.

The robot **12** may operate in one of two different modes; an exclusive mode, or a sharing mode. In the exclusive mode only one user has access control of the robot. The exclusive mode may have a priority assigned to each type of user. By way of example, the priority may be in order of local, doctor, caregiver, family and then service user. In the sharing mode two or more users may share access with the robot. For example, a caregiver may have access to the robot, the caregiver may then enter the sharing mode to allow a doctor to also access the robot. Both the caregiver and the doctor can conduct a simultaneous tele-conference with the patient.

The arbitration scheme may have one of four mechanisms; notification, timeouts, queue and call back. The notification mechanism may inform either a present user or a requesting user that another user has, or wants, access to the robot. The timeout mechanism gives certain types of users a prescribed amount of time to finish access to the robot. The queue mechanism is an orderly waiting list for access to the robot. The call back mechanism informs a user that the robot can be accessed. By way of example, a family user may receive an e-mail message that the robot is free for usage. Tables 1 and 2, show how the mechanisms resolve access request from the various users.

TABLE I

User	Access Control	Medical Record	Command Override	Software/Debug Access	Set Priority
Robot	No	No	Yes (1)	No	No
Local	No	No	Yes (2)	No	No
Caregiver	Yes	Yes	Yes (3)	No	No
Doctor	No	Yes	No	No	No
Family	No	No	No	No	No
Service	Yes	No	Yes	Yes	Yes

TABLE II

		Requesting User				
		Local	Caregiver	Doctor	Family	Service
Current User	Local	Not Allowed	Warn current user of pending user Notify requesting user that system is in use Set timeout	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m Call back	Warn current user of pending user Notify requesting user that system is in use No timeout Call back
	Caregiver	Warn current user of pending user. Notify requesting user that system is in use. Release control	Not Allowed	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m Queue or callback	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m	Warn current user of pending user Notify requesting user that system is in use No timeout Callback
	Doctor	Warn current user of pending user Notify requesting user that system is in use Release control	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m	Warn current user of pending user Notify requesting user that system is in use No timeout Callback	Notify requesting user that system is in use No timeout Queue or callback	Warn current user of pending user Notify requesting user that system is in use No timeout Callback
	Family	Warn current user of pending user Notify requesting user that system is in use Release Control	Notify requesting user that system is in use No timeout Put in queue or callback	Warn current user of pending user Notify requesting user that system is in use Set timeout = 1 m	Warn current user of pending user Notify requesting user that system is in use Set timeout = 5 m Queue or callback	Warn current user of pending user Notify requesting user that system is in use No timeout Callback
	Service	Warn current user of pending user Notify requesting user that system is in use No timeout	Notify requesting user that system is in use No timeout Callback	Warn current user of request Notify requesting user that system is in use No timeout Callback	Warn current user of pending user Notify requesting user that system is in use No timeout Queue or callback	Not Allowed

The information transmitted between the station **16** and the robot **12** may be encrypted. Additionally, the user may have to enter a password to enter the system **10**. A selected robot is then given an electronic key by the station **16**. The robot **12** validates the key and returns another key to the station **16**. The keys are used to encrypt information transmitted in the session.

FIG. **8** shows a robot head **200** that can both pivot and spin the camera **38** and the monitor **40**. The robot head **200** can be similar to the robot **12** but without the platform **110**. The robot head **200** may have the same mechanisms and parts to both pivot the camera **38** and monitor **40** about a pivot axis **4**, and spin the camera **38** and monitor **40** about a spin axis **5**. The pivot axis may intersect the spin axis. Having a robot head **200** that both pivots and spins provides a wide viewing area. The robot head **200** may be in the system either with or instead of the mobile robot **12**.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.

What is claimed is:

1. A remote controlled robot, comprising:

a plurality of robots, each robot having a robot camera, a robot camera, a robot microphone, and a robot speaker;

a remote station that can establish a connection with said robot, said remote station including a station camera, a station monitor, a station microphone, a station speaker;

a server that contains a database that defines a first subset of said plurality of robots as associated with a first customer identification (ID) and a second subset of said plurality of robots as associated with a second customer ID; and,

a manager control station that can access said server to edit which of said plurality of robots is associated with said first subset of robots or said second subset of robots, wherein, when said connection between said remote station and said robot is established, the robot monitor displays an image captured by the station camera, the station monitor displays an image captured by the robot camera, the station microphone reproduces a sound captured by the robot microphone, and the robot speaker reproduces a sound captured by the station microphone.

2. The system of claim **1**, wherein said connection includes a plurality of privileges.

3. The system of claim **2**, wherein said privileges include an ability to operate said robot.

4. The system of claim **2**, wherein said privileges include an ability to participate in a session with another remote station.

5. The system of claim **2**, wherein said privileges include an ability to view a video image captured by said robot camera.

6. The system of claim **2**, wherein said privileges include an ability to hear audio captured by a robot microphone.

7. The system of claim **2**, wherein said privileges include an ability for the video image captured by a control station camera to be displayed on said robot monitor.

8. The system of claim **2**, wherein said privileges include an ability for the audio captured by a control station microphone to be played by a robot speaker.

9. The system of claim **2**, further comprising an auxiliary device that can be coupled to said robot, and said privileges include an ability to access said auxiliary device attached to said robot.

10. The system of claim **2**, wherein said server includes a privilege map that is transferred to said remote control station.

11. The system of claim **1**, wherein said robot includes a mobile platform.

12. The system of claim **1**, wherein said system includes a plurality of remote stations and said database associates each of the plurality of remote stations with a customer ID.

13. The system of claim **1**, wherein said connection between said remote control station and said robot is established by a time window.

14. The system of claim **1**, wherein said server provides a user interface that allows one or more connectivity rules to be subtracted.

15. A method for connecting a remote station to one of a plurality of robots, comprising:

accessing, via a manager control station, a server that contains a database that defines a first subset of said plurality of robots and a second subset of said plurality of robots, each of the plurality of robots having a robot camera, a robot monitor, a robot microphone, and a robot speaker;

associating, via an input of the manager control station, the first subset of said plurality of robots with a first customer identification (ID) and the second subset of said plurality of robots with a second customer ID;

establishing a connection between a remote station and one of a plurality of robots, each remote station having a station camera, a station monitor, a station microphone, and a station speaker;

displaying an image captured by the station camera on the robot monitor;

displaying an image captured by the robot camera on the station monitor;

reproducing a sound captured by the robot microphone via the station speaker;

reproducing a sound captured by the station microphone via the robot speaker; and,

accessing, via the manager control station, the server to edit which of said plurality or robots is associated with said first subset of robots or said second subset of robots.

16. The method of claim **15**, wherein connection includes a connectivity privilege.

17. The method of claim **15**, wherein the privilege includes an ability to participate in a session with another remote station.

18. The method of claim **15**, wherein the privilege includes an ability to view a video image captured by the robot camera.

19. The method of claim **15**, wherein the privilege includes an ability to operate the robot.

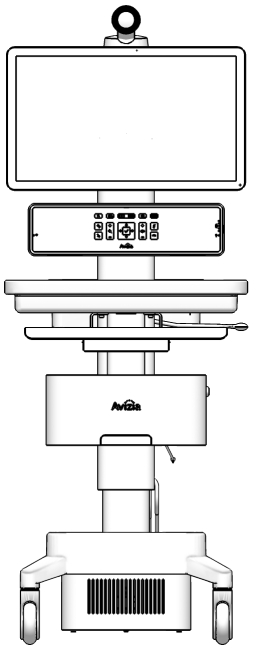
* * * * *

Exhibit J

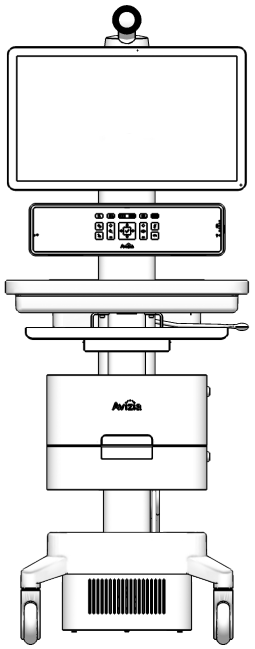
Avizia

CA750

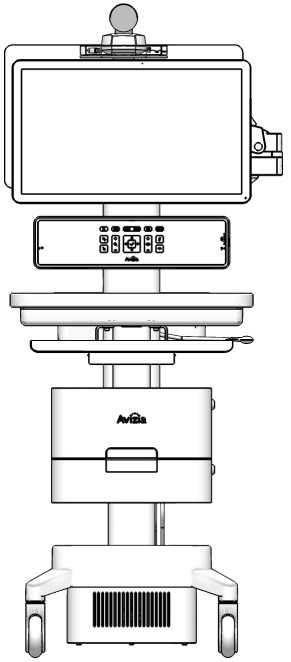
User & Installation Guide



AVZ-CA750-1-IP40



AVZ-CA750-2-IP40



AVZ-CA750-3-IP40

AVZ-CA750-DOC-UIG-04 (270593.D)

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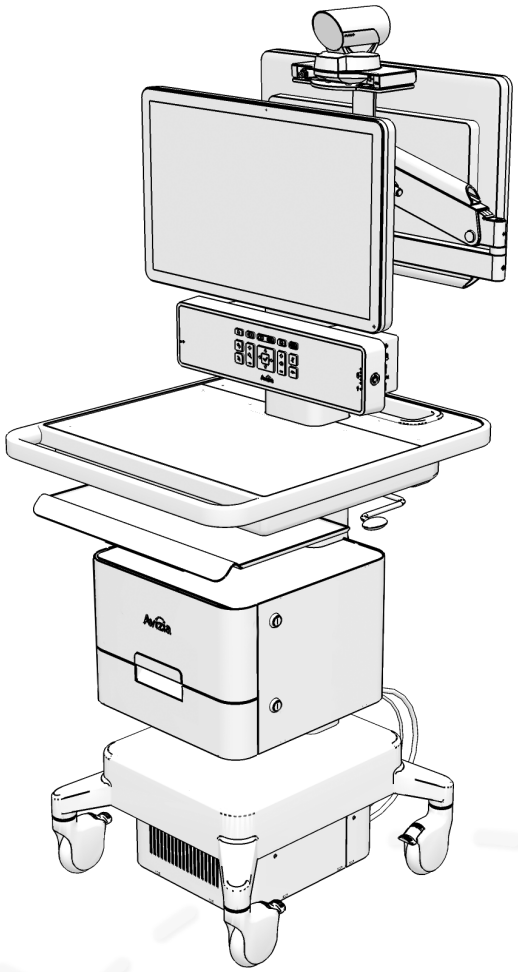
Before getting started



- Indications for use
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Indications for use

The Avizia CA750 enables secure and effective audio/video communication between multiple healthcare providers and between providers and patients. The system transmits real-time audio and video captured by a high-definition camera and integrated microphone. It also receives real-time audio and video from a similar system in a remote location. Finally, the CA750 supports transmission of real-time audio and video from peripheral audio/visual medical devices, which may be connected to standard audio and video inputs provided on the system.

The CA750 is intended to facilitate remote provider/patient and provider/provider consultations. These consultations should always be conducted with a licensed medical professional physically in the room with the patient.

Contraindications

The CA750 is not intended to substitute for the in-person physical examination of a patient or as a substitute for direct medical intervention. It is also not intended for real-time, active, or online patient monitoring, nor is it intended to provide time sensitive data or alarms. The CA750 does not support transmission of numerical telemetric/serial data and is not intended for use with non-audio/visual medical devices.

Safety precautions

Warnings

Do not modify this equipment without authorization from the manufacturer!

Precaution should be taken during transportation of the system. It is recommended that the operator use caution when wheeling the unit over doorstops and/or into elevators to ensure their safety and prevent damage to the unit.

For Customers In North America

This equipment complies to the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, which may cause harmful interference to radio communications.

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment

Environmental considerations

Thank you for buying a product which contributes to a reduction in pollution, and thereby helps save the environment. Our products reduce the need for travel and transport and thereby reduce pollution. Our products have either none or few consumable parts (chemicals, toner, gas, paper). Our products are low energy consuming products.

Battery Handling

Batteries for the Remote Control are Long Life Alkaline batteries; please follow guidelines on the packing material for handling and disposal of the batteries.

The system enclosed rechargeable battery is non-user replaceable and should be removed by a qualified service technician only.

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO MANUFACTURER INSTRUCTIONS.

Production of Products

Our factories employ efficient environmental methods for reducing waste and pollution and ensuring the products are recyclable.

Waste handling

EU Battery and WEEE Directives

For product safety and data integrity reasons the permanently affixed battery should only be removed or replaced professionally by a repair technician or waste management professional. Please contact Avizia or an authorized service agent if the product fails to perform due to malfunction of the permanently affixed battery.

This symbol on the product, battery or packaging means that the product and/or battery should not be disposed of with your household waste.

It is your responsibility to dispose of your waste equipment and batteries separately from your household waste and in accordance with local laws and regulations. The correct disposal of your old equipment and batteries will help prevent potential negative consequences for the environment and human health.

Please use the nearest waste collection facility as directed by your municipality or your retailer.

Warnings

Not Intended For Dialing Emergency Medical Services

The CA750 is not intended to make emergency calls. In the event of an emergency, the user should use a telephone or device other than the CA750 to call local emergency services.

Use medically approved devices

Ensure that any device connected to the CA750 power outlets conforms to IEC 60601-1 standards in order to maintain compliance. Connecting electrical equipment to the CA750 effectively creates a new system, which can result in a reduced level of safety.

Loss of Connectivity

During the use of the CA750, a healthcare professional may lose connectivity with the system. Loss of connectivity can result from power outages, network outages, failure in the CA750 software/hardware, or other causes. Loss of connectivity can prevent a health care professional from completing a patient session in a timely manner. In cases where time is critical, the user should not use the CA750 and seek an in-person examination from a licensed health care professional.

Delay or Choppiness of Audio or Video Transmission

The CA750 may operate at a delay of up to 150 milliseconds, depending on network condition. This means that the provider may experience the audio and video transmissions later then they are really occurring. In cases where the remote health care provider needs to make time sensitive assessments or give instructions this delay may result in misalignment of audio and visual transmissions to the real-time procedure and/or inappropriate treatment or diagnosis.

Proper Training Is Required

Healthcare professionals using the CA750 should be sufficiently trained and familiar with the Installation and User Guide and the instructions for use. Please refer to this guide under “Troubleshooting”, “Safety Precautions” and “Operator Safety.”

Go to http://support.avizia.com for additional support content.

Audio and Video Distortions

The CA750 can experience audio and video distortions due to network latency, software/hardware malfunction, insufficient bandwidth, or for other reasons. If audio or video is not of sufficient quality for the intended use of the CA750, please refer to:

- this guide under “Technical Specifications” and “Troubleshooting,” or visit: http://support.avizia.com
- Cisco SX20 codec documentation at: http://cisco.com/go/sx-docs

Network and Signal Input/Output

The network and signal input/output ports must only be connected to Low Voltage SELV connections.

Operator safety summary

For your protection, please read these safety instructions completely before operating the equipment and keep this manual for future reference. The information in this summary is intended for persons who operate the equipment as well as repair (servicing) personnel. Carefully adhere to all warnings, precautions and instructions on the apparatus, and the ones described in the operating instructions.

Also, adhere to safety guidelines found in manuals for any peripheral equipment.

This system contains no user-serviceable parts: The system enclosed battery (rechargeable battery for use in temporary relocation) in this product is non-user replaceable and should be removed by a qualified service technician only.

To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

Lower before transporting: For your safety and to protect the CA750, fully lower the work surface before transporting the system. Pushing or pulling the system with any part of the system other than its handle may result in damage to the system.

Traversing thresholds and obstacles on the ground: Use the system handle to PULL the system safely across thresholds, cords, cables, and other potential obstacles on the ground. Always fully lower the work surface before transporting the system.

- Water and moisture - Do not operate the equipment under or near water - for example near a bathtub, kitchen sink, or laundry tub, in a wet basement, or near a swimming pool or in areas with high humidity.
- Cleaning - Unplug the apparatus from the wall outlet before cleaning or polishing. Please adhere to the general cleaning guidelines found in this document's section: "Cleaning the System."
- Power-Cord Protection - Route the power cord so as to avoid it being walked on or pinched by items placed upon or against it, paying particular attention to the plugs, receptacles, and the point where the cord exits from the apparatus.
- Mobility – Before transporting the system unplug the power cord and wrap it around the cable hook. Also ensure that the camera and display are in the operational position (facing forward) and not in the maintenance position (facing upward). Use the system handle to maneuver the system. Pull the system over thresholds, cords, cables, and other obstacles on the ground. Fully lower the work surface before transporting the system.
- Ventilation - Do not block any of the ventilation openings of the apparatus. Install in accordance with the installation instructions. Never cover the slots and openings with a cloth or other material. Never install the apparatus near heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
- Attachments - Only use attachments as recommended by the manufacturer.
- Accessories - Use only accessories intended for use with this system.
- Lightning - Unplug this apparatus during lightning storms or when unused for long periods of time.
- Servicing - Do not attempt to service the apparatus yourself as opening or removing covers may expose you to dangerous voltages or other hazards, and will void the warranty. Refer all servicing to qualified service personnel.
- Opening the System - Do not open system service panels while system is in use.
- Storage - If you need to store the system, ensure that it is stored in a controlled environment to avoid damage. Refer to the codec documentation for further guidelines.
- Repacking – We recommend you save and store the system's packing materials. They make for an ideal container with which to transport the system.
- Damaged Equipment - Unplug the apparatus from the outlet and refer servicing to qualified personnel under the following conditions:
  - When the power cord or plug is damaged or frayed
  - If liquid has been spilled or objects have fallen into the apparatus
  - If the apparatus has been exposed to rain or moisture
  - If the apparatus has been subjected to excessive shock by being dropped, or the unit has been damaged
  - If the apparatus fails to operate in accordance with the operating instructions.
  - Cart is heavy. Move with caution.
  - Use wheel locks when cart is stationary.
  - Fold in 2nd monitor in proper position before transporting.

Important safeguards

Using System in a Medical Environment

No currently available technology can completely substitute the in-person physical examination of an individual patient. Avizia Telemedicine products provide high quality audio and video experiences; when used properly, these products provide a valuable tool for medical professionals. The use and value of the system will vary depending on the specific circumstances of the patient condition, data transmission speeds, and the capabilities of the local environment. Ultimately, the local medical professional supervising the patient's care should judge how this system is to be utilized.

The leakage current could increase when connected to other equipment.

Warning on Power Connection

Use only with the supplied power cords or cords that meet local hospital-grade requirements. Users in the United States and Canada should use hospital-grade cords that meet the following requirements:

	United States	Canada
Plug Type	Hospital Grade	Hospital Grade
Cord Type	SJT3 x 16 AWG	SJT3 x 16 AWG
Minimum Cordset Rating	13A/125V	13A/125V
Safety Approval	UL	UL

NEVER USE AN EXTENSION CABLE TO POWER THE SYSTEM.

ElectroStatic Discharge (ESD)

When subjected to an electrostatic discharge the Precision-HD camera image may suffer momentary interruption - this will self-recover in a few seconds after the discharge.

To avoid excess electrostatic discharge, floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.

Equipment markings

The “exclamation mark” within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions within literature accompanying the equipment.

Manufacturer

Follow instructions for use.
Suivez les instructions d’utilisation.

Pushing or pulling the system with any part of the system other than the handle may result in damage to the system. Always fully lower the work surface before transport and use the system handle to maneuver.

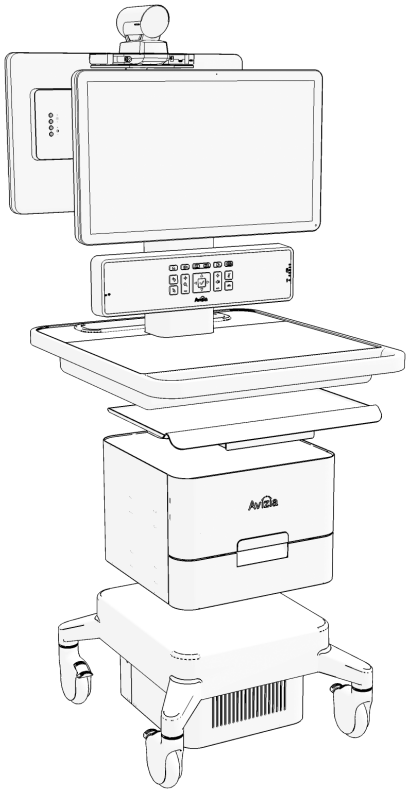
Use the handle to pull the system safely across thresholds, cords, cables, and other potential obstacles on the ground. Always fully lower the work surface before transporting the system.

NOTICE
No currently available technology can completely substitute the in-person physical examination of an individual patient. Avizia Telemedicine products provide high quality audio and video experiences; when used properly, these products provide a valuable tool for medical professionals. The use and value of the system will vary depending on the specific circumstances of the patient condition, data transmission speeds, and the capabilities of the local environment. Ultimately, the local medical professional supervising the patient’s care should judge how this system is to be utilized.

NOTICE
The plug below has a 1 AMP max.

Located on the rear of the system on the system column.

Getting started



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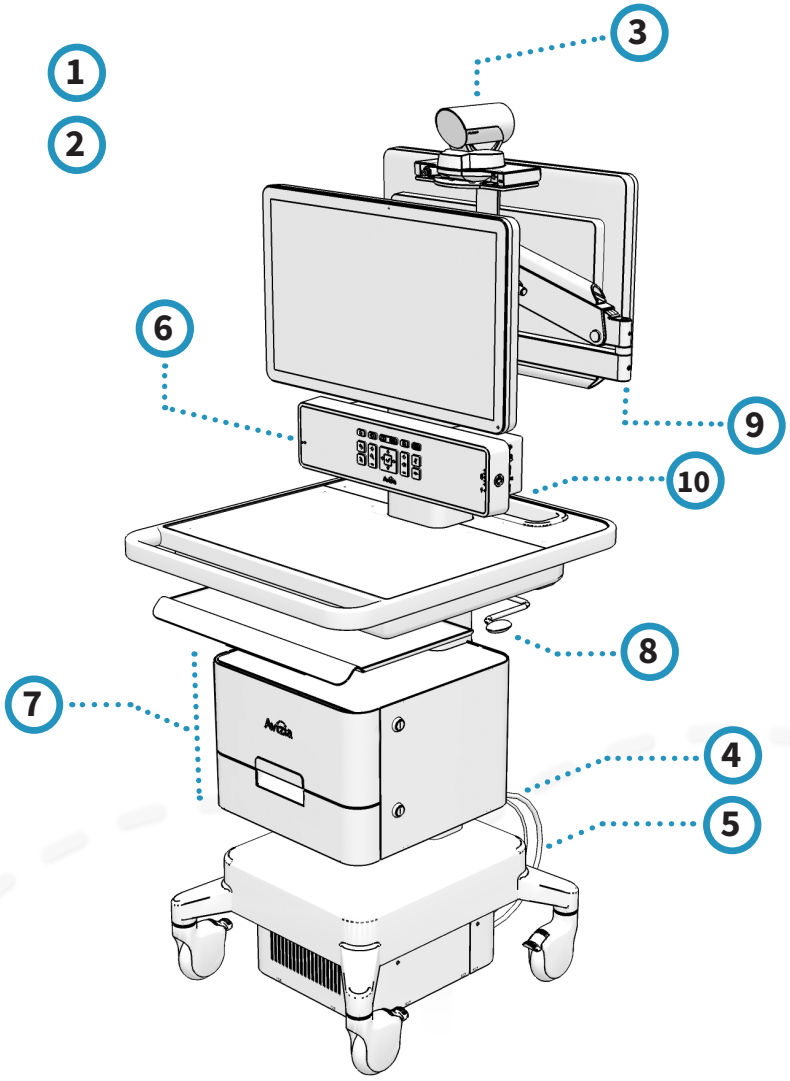
Initial setup

Refer to the **Avizia CA750 Quick Start Guide** (included with the system packaging) for procedures pertaining to initial system setup. The Quick Start Guide includes the following items:

1. System overview
2. Unpacking the system
3. Mounting and connecting the camera
4. Providing system power and turning on the cart
5. Providing network using an Ethernet cable
6. Providing network using a wireless network
7. Peripheral drawer and PC drawer option
8. Adjusting the cart height
9. Adjusting the second display arm
10. Utilizing Auxiliary power



The **CA750 Quick Start Guide** (AVZ-CA750-DOC-QSG) is included on the outside of the system packaging. It can also be found online at http://support.avizia.com.

Best practices

Enable Auto-answer

Setting your system to auto-answer can be a good way to make sure you don't miss a call. You can toggle auto-answer on by accessing the Cisco codec menu system with the system console controls.

Press ✓ (OK) to bring up the Home menu and use the Directional pad to navigate the system menu:

- HOME > SETTINGS > **CALL SETTINGS**...
- Configure the auto answer settings

We recommend you download the user documentation for details and advanced Cisco SX20 codec functions. Go to: **http://cisco.com/go/quickset-docs**.

Plug in when storing system

We recommend that the system is plugged in to an electrical outlet when storing the CA750. This ensures that the system battery maintains a full charge and is ready when needed.

Use call history for quick redial

When calls are placed , missed or received, navigating to your Recent calls list allows you to utilize contacts quickly.

Press ✓ (OK) to bring up the Home menu and use the Directional pad to navigate the system menu:

- HOME > CALL > **RECENT CALLS**...
- Select contact to call

Save frequently called numbers

You can save frequently called or favorite video numbers to make them that much easier to call.

Press ✓ (OK) to bring up the Home menu and use the Directional pad to navigate the system menu:

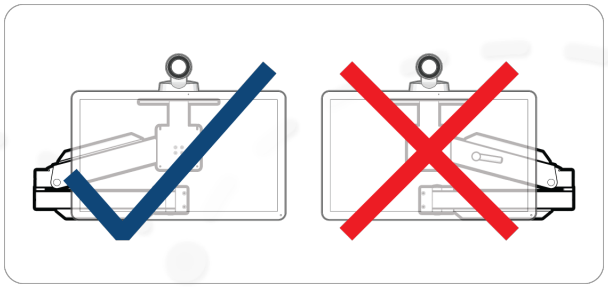
- HOME > CALL... select **PHONE BOOK** or **RECENT CALLS**...
- Select contact and choose SAVE TO MY CONTACTS

To place a call from the My contacts directory, press ✓ (OK) to bring up the Home menu and use the Directional pad to navigate the system menu:

- HOME > CALL > PHONE BOOK > **MY CONTACTS**...
- Select contact to call

Storing the second display

When collapsing the second display to its folded position, heed the labels on either side of the arm and ensure that the bend in the arm is positioned to the left of the second display as you are facing the back of the cart.



Set peripheral sharing resolution

The CA750's content sharing settings are factory set to optimize the bandwidth allocation to the shared content source when in a video call. As call bandwidth decreases, the codec will allocate more bandwidth to the shared content stream from the main source stream. This allows the shared content (scope image, computer presentation, etc.) to be presented as clearly as possible in lower bandwidth situations.

The default settings are found in the following menu tabs, and can be adjusted as needed or desired:

HOME
- SETTINGS
  - ADVANCED CONFIGURATION
    - CONFERENCE 1
      - VIDEO BANDWIDTH
        - MAIN CHANNEL
          - **WEIGHT: 1**
        - **MODE: DYNAMIC**
        - PRESENTATION CHANNEL
          - **WEIGHT: 10**
    - VIDEO
      - INPUT
        - SOURCE 2
          - **QUALITY: MOTION**

System overview

What's included:

- CA750 system cart
- PrecisionHD Camera with camera mounting screw
- Display (single or dual display with articulating arm)
- Remote control with batteries
- Key for locking drawer(s)
- Auxiliary power share cord
- USB flash drive
- Hex key set

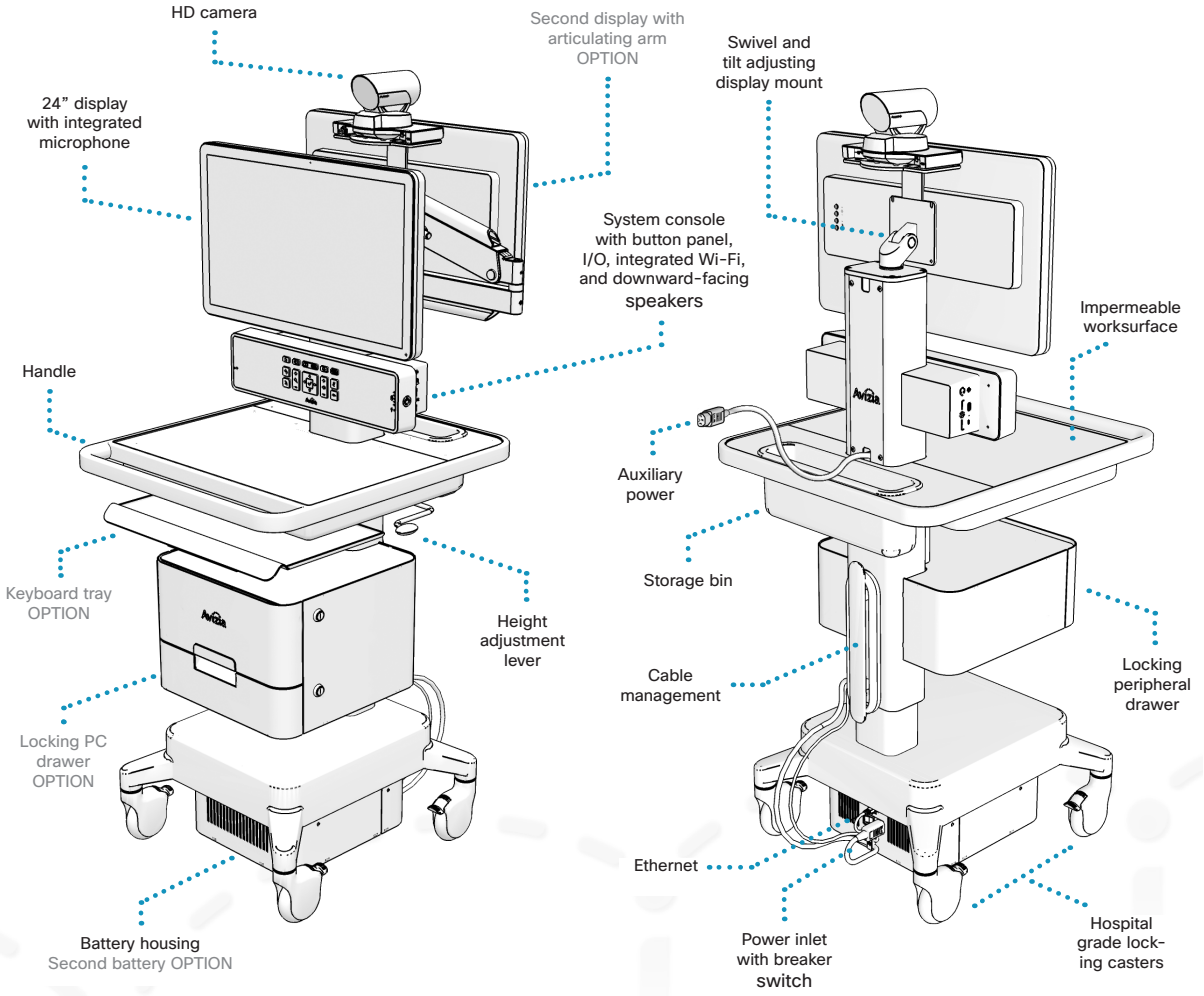
Configurations and Options:

- MultiSite certificate
- HORUS Scope and accessories
- PC drawer with cables (power, Ethernet, 3.5mm audio, and HDMI to HDMI) — to integrate a user-supplied Ultra-Small Form Factor (USFF) PC.
- Keyboard tray
- Retractable power and/or network caddy

Tools Required for Assembly

Refer to the **CA750 Quick Start Guide** (AVZ-CA750-DOC-QSG) included on the outside of the system packaging for initial assembly and setup.

The user documentation for this product, including compliance and safety information, is found on the Avizia website. Go to http://www.avizia.com.

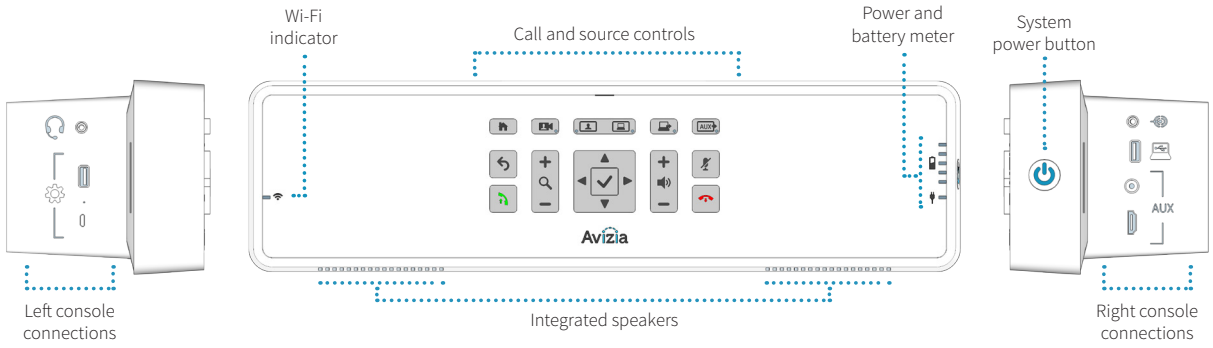


System overview

Console overview

System navigation, call controls, and connectivity to peripheral sources can all be done through the system's console.

Please see **Using the system** to understand the console interface and how to use the CA750 system.



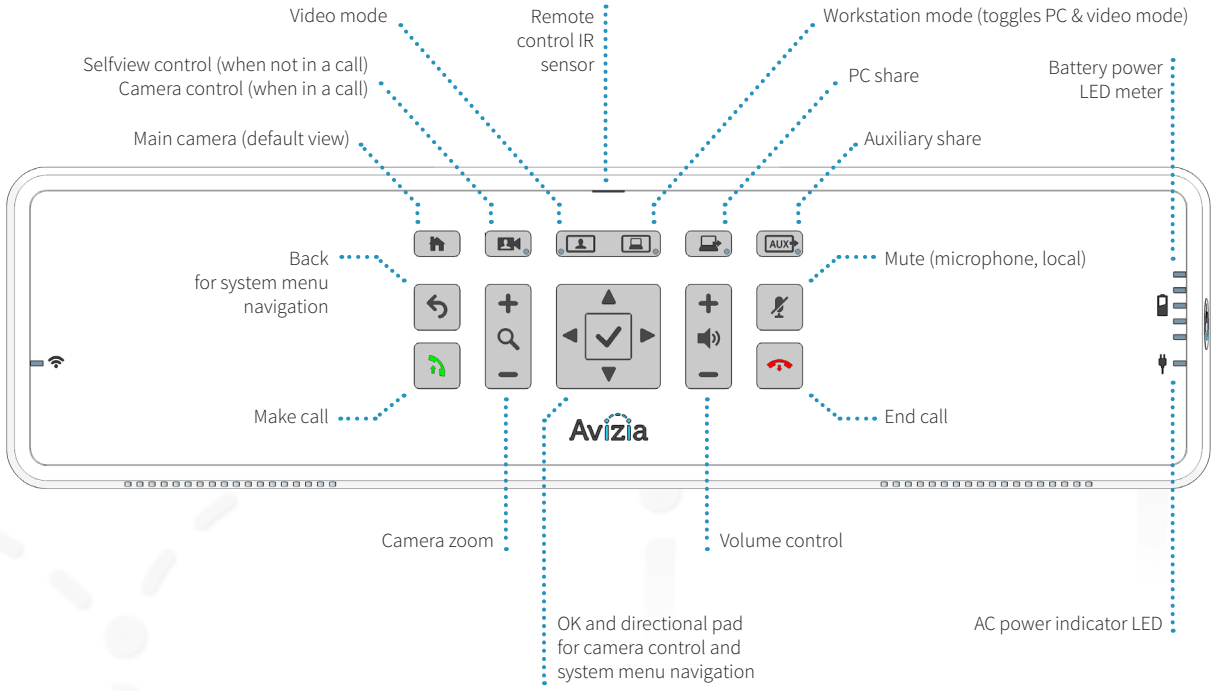
Power indicator LED states

AC Power

system is plugged into an outlet

Battery meter

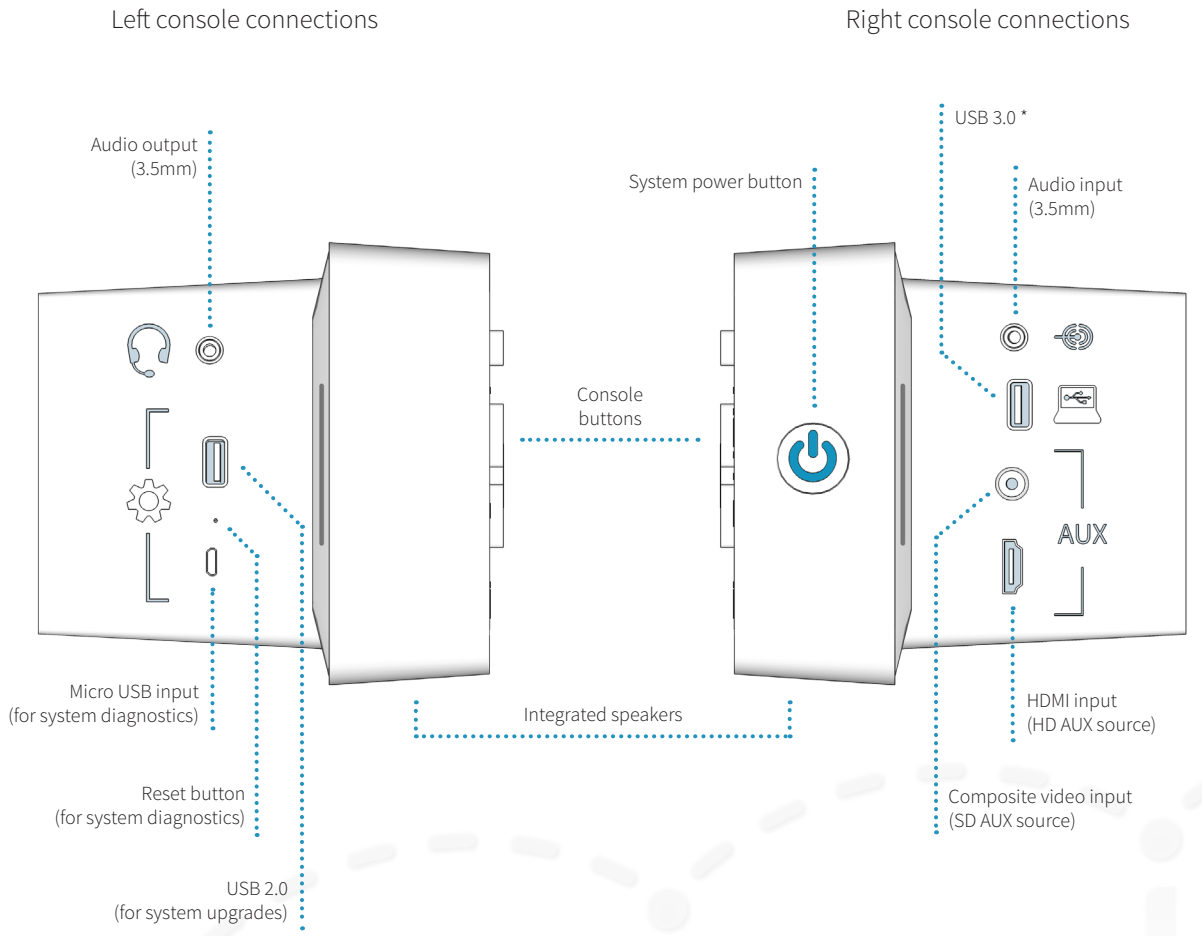
- 100% battery capacity (BLUE)
- 80% battery capacity (BLUE)
- 60% battery capacity (BLUE)
- 40% battery capacity (BLUE)
- 20% battery capacity (AMBER) 10% capacity when flashing



System overview

Console connections overview

The left and right console connections allow the user to connect peripheral devices that will enhance the CA750's capabilities.



* USB port provides only charging functionality when there is no PC integrated into the optional PC drawer.
When a PC is integrated into the optional PC drawer with the provided USB connection, the console's USB port functions as an extension or hub to the PC's USB port.

Power considerations and configuration

The CA750 can run on AC or battery power.

When the system is plugged into an outlet, the Power LED on the System Console will light up solid blue in about 10 seconds. The integrated battery will also begin charging.

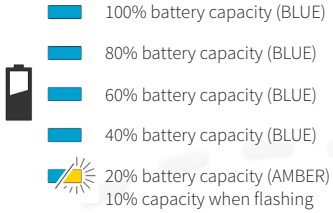
NOTE Though the system will arrive with some charge, we recommend you charge the system battery for at least 4 hours before running on battery power.

NOTE Smart power management will prevent over-charging and provide feedback for remaining battery capacity.

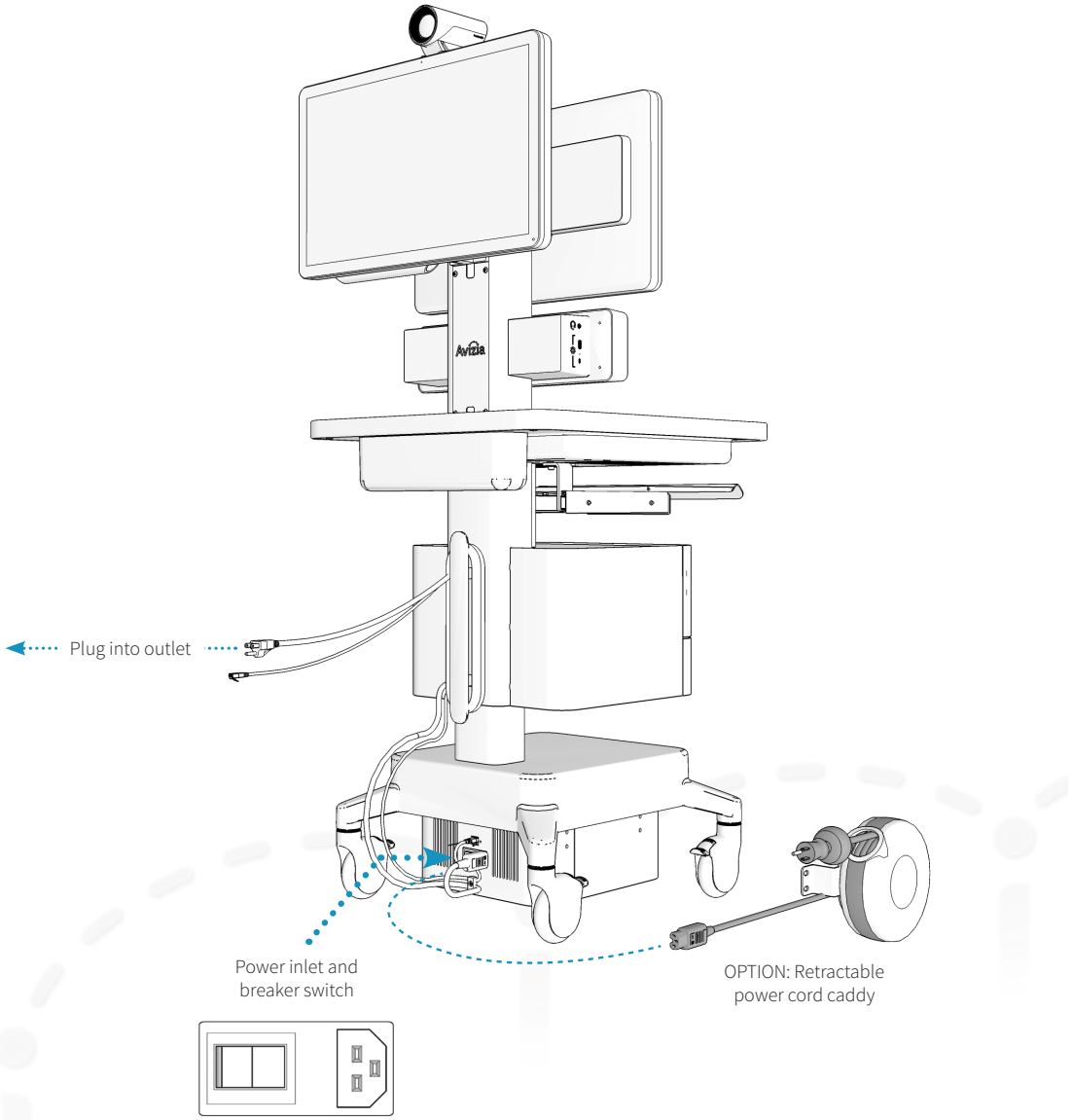
Each system includes a standard single or optional dual battery to power the cart when not connected to AC power.

	SINGLE BATTERY	DUAL BATTERY (OPTION)
		
RUN TIME	3-4 hours	6-8 hours
CHARGE TIME	1.5 hours	3.5 hours

BATTERY CAPACITY LED



NOTE The system includes a breaker switch for protection. Should the system indicate there is no power, check the breaker and ensure that it is switched to the ON position.

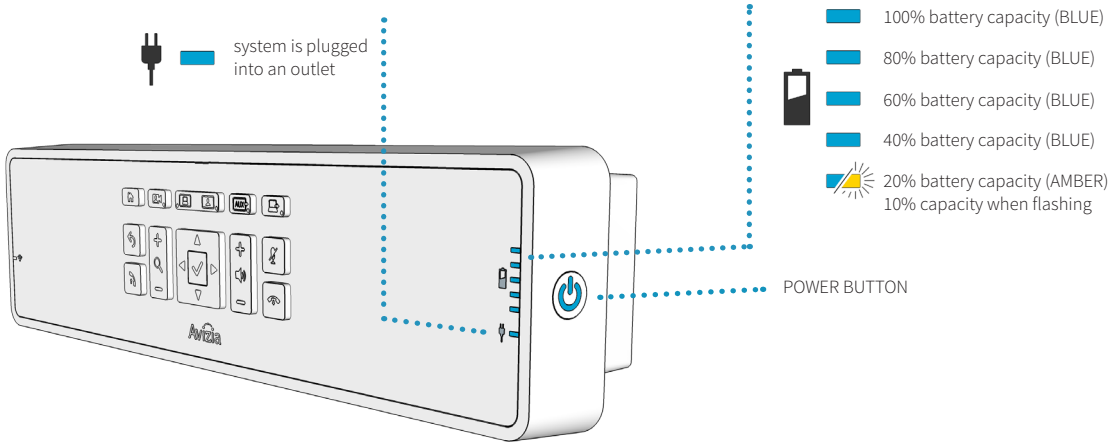


Power considerations and configuration

Turning the system ON

Press the system's Power Button on the side of the Console to turn ON the system. This button will illuminate blue when active, and the codec, camera, and display(s) will power on.

While the system is plugged into AC or running on battery, power will be available to the appropriate console, peripheral, and optional PC connections (e.g. auxiliary power cord, peripheral drawer, optional PC drawer, USB ports).



Power considerations and configuration

System power modes

ACTIVE MODE

Pressing the POWER BUTTON on the console will activate the codec, camera, and display(s).

While the system is plugged into AC or running on battery, power will be available to the appropriate console, peripheral, and optional PC connections (e.g. auxiliary power cord, peripheral drawer, optional PC drawer, USB ports).

STANDBY MODE

If the system is inactive for 10 minutes, the codec, camera, and display(s) will enter STANDBY MODE to conserve power. The camera will turn to its side and the display(s) will turn off (the blue indicator light will not be lit).

NOTE If a PC is connected to a dual display cart, then the front-facing display will not enter standby mode unless:

1. The PC also is configured separately to enter standby or sleep.

2. The system is in VIDEO MODE.

When in Standby, the system can be activated by any button press, detection of the codec's remote control, or an incoming call.

SLEEP / DO NOT DISTURB MODE

Pressing the system's Power Button on the side of the Console for one second will place the system into SLEEP MODE. The blue light for the power button will go dark, the codec will enter DO NOT DISTURB mode, the camera will turn to its side, and the display(s) will turn off (the blue indicator light will not be lit).

The system cannot be used, though power is still provided to the rest of the system where powered connections are made available (e.g. auxiliary power cord, peripheral drawer, optional PC drawer, USB ports).

NOTE Any device (PC, scope, etc.) connected to power the powered connections will remain on until otherwise placed into standby, turned off, or disconnected.

To return the system to ACTIVE MODE, press the power button on the side of the console to activate the codec, camera, and display(s).

Network considerations and configuration

The network module is built into the console of the CA750 and is a dual-band Wi-Fi IEEE 802.11 a/b/g/n wireless network module. The network module can be used in one of two ways: connected to the network infrastructure by Ethernet cable, or connected over the Wi-Fi infrastructure.

It is important that you understand how your wireless infrastructure is configured BEFORE you connect the CA750 to your wireless network.

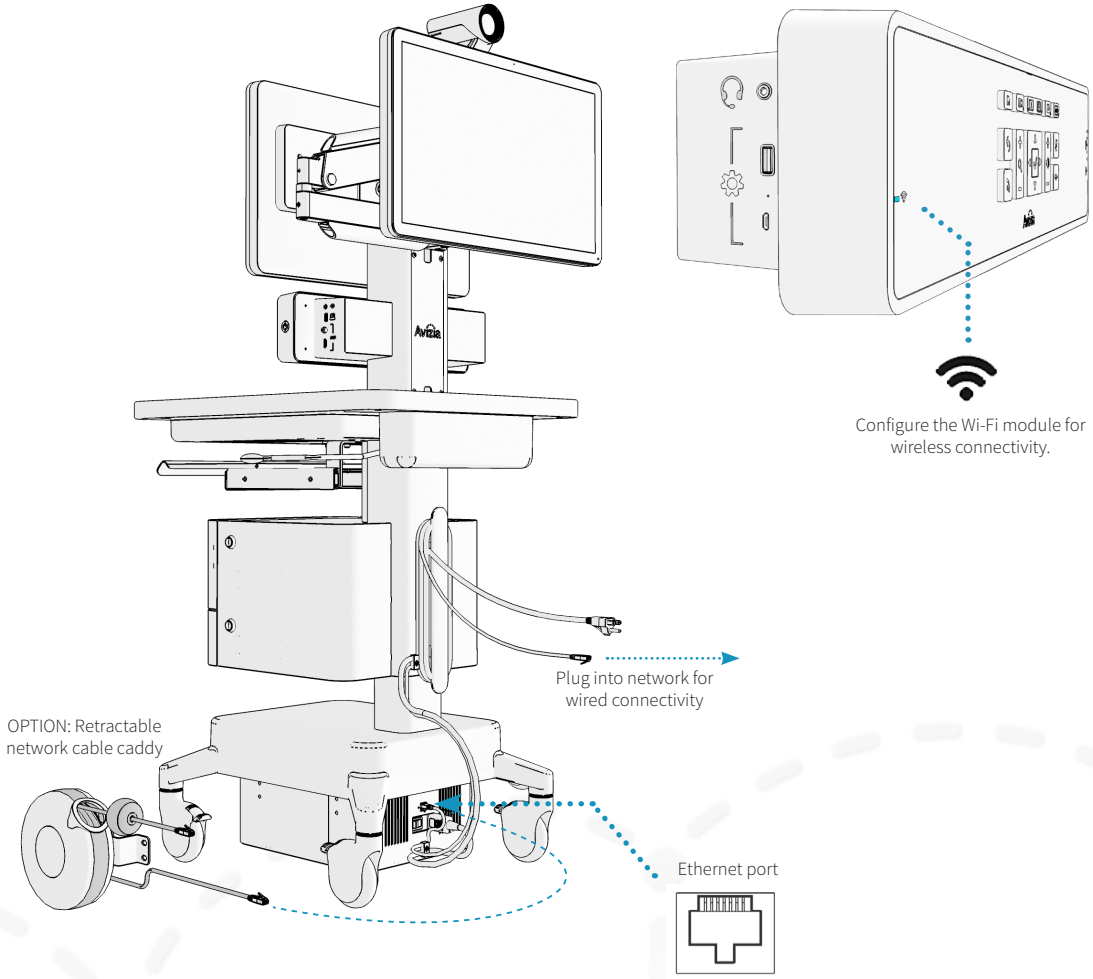
Determine how you will set up your cart to connect to your wireless network, as this may affect your wireless network settings:

Single Client mode allows a one-to-one connection to the wireless network. No other networked devices on the cart will have connectivity except the video codec.

Multi-Client mode allows multiple devices to connect to the wireless network. In most cases, “client-bridge” or “passive client” mode must be enabled on the wireless network before devices can obtain an IP address.

The wireless radio switches off when the system detects a wired network connection. To enable wireless, disconnect the Ethernet cable at the base of the cart.

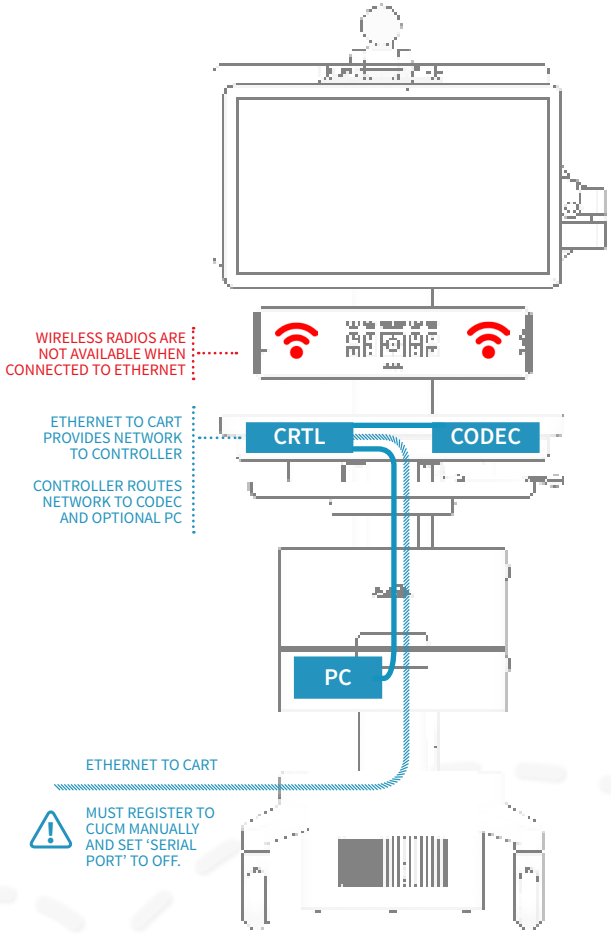
The system is ready use once the cart has network connectivity and the video codec (Cisco SX20) has been registered to the video infrastructure. For more information on registering your codec and setting a static IP address, please reference the Cisco SX20 Quick Set Administrator Guide:
http://j.mp/Cisco-SX20-Admin



Network considerations and configuration

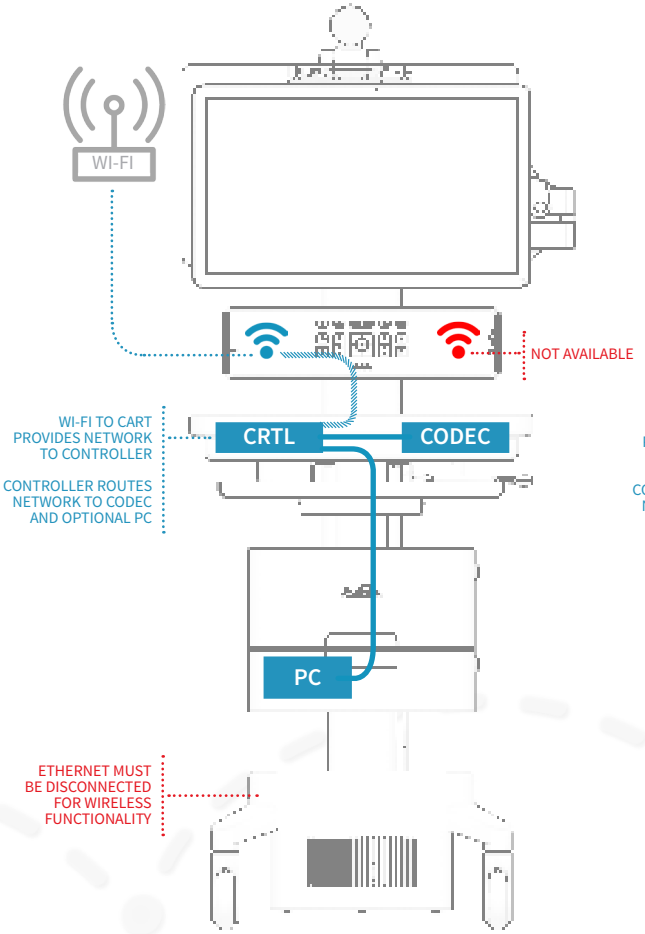
WIRED CONNECTION

You must manually register the Cisco codec to the CUCM and ensure that the SERIAL PORT setting is set to OFF.

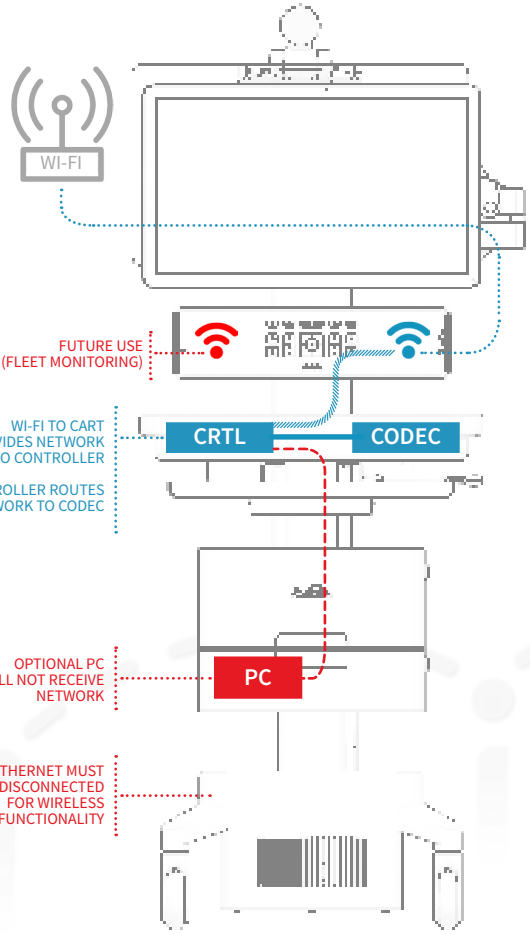


MULTI-CLIENT WI-FI

Your wireless infrastructure must allow Client-Bridge access (e.g. passive client mode).



SINGLE-CLIENT WI-FI



Network considerations and configuration

Connecting to a wired network

Plug the cart's Ethernet Cable into an active network port. The cable will be installed and ready to use. The optional Retractable Network Caddy may be used in place of the standard cable.

The system is ready to use when the Network LED on the console is a solid blue (network connection is detected) and the codec is registered to your network.

NOTE The Wi-Fi radio will be disabled when the system detects an active wired Ethernet connection.

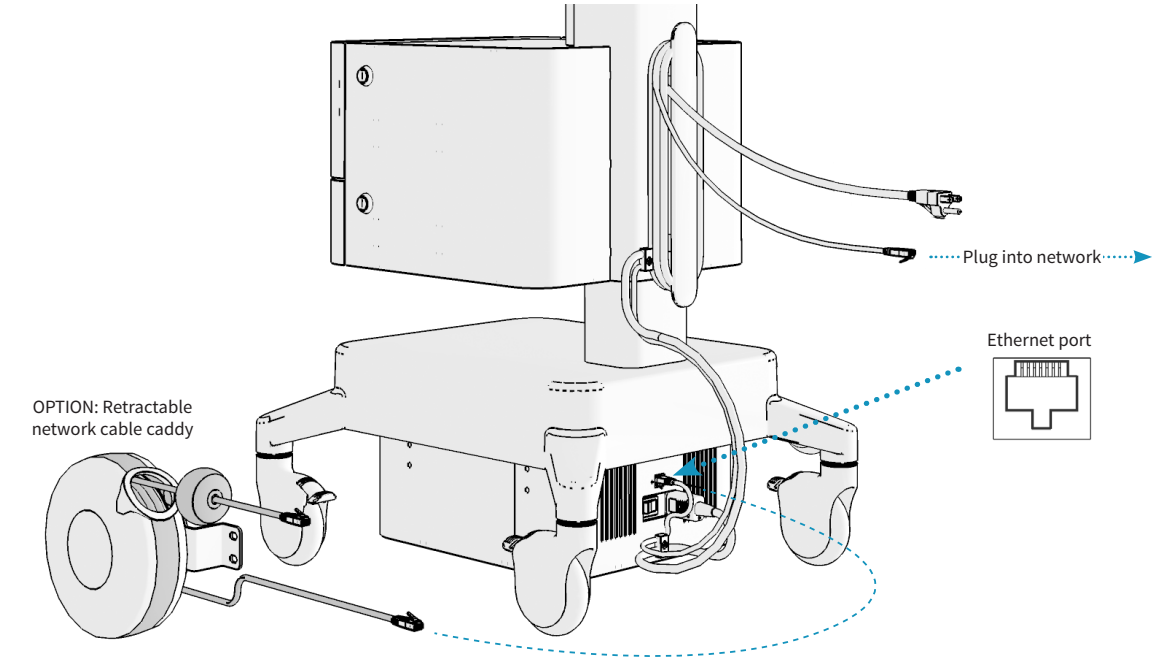
If the LAN has a DHCP service, the system will retrieve a DHCP IP address, which will be displayed in the upper left hand corner of the display.

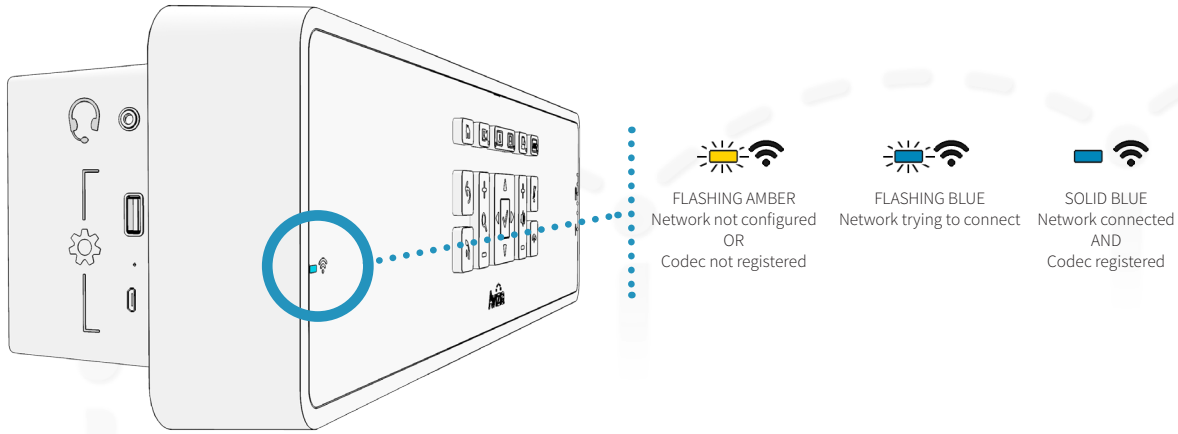
If a static IP is required for the CA750 then this requires configuring the SX20 endpoint within the CA750.

For more information on registering your codec and setting a static IP address, please reference the Cisco SX20 Quick Set Administrator Guide for the SX20: http://j.mp/Cisco-SX20-Admin.

For a wired network connection only: You must manually register the Cisco codec to the CUCM and ensure that the SERIAL PORT setting is set to OFF.

The system can be configured to operate on a wireless network. To configure the system for wireless operation, please refer to **Connecting to a wireless network** in the next section.





Network considerations and configuration

Connecting to a wireless network

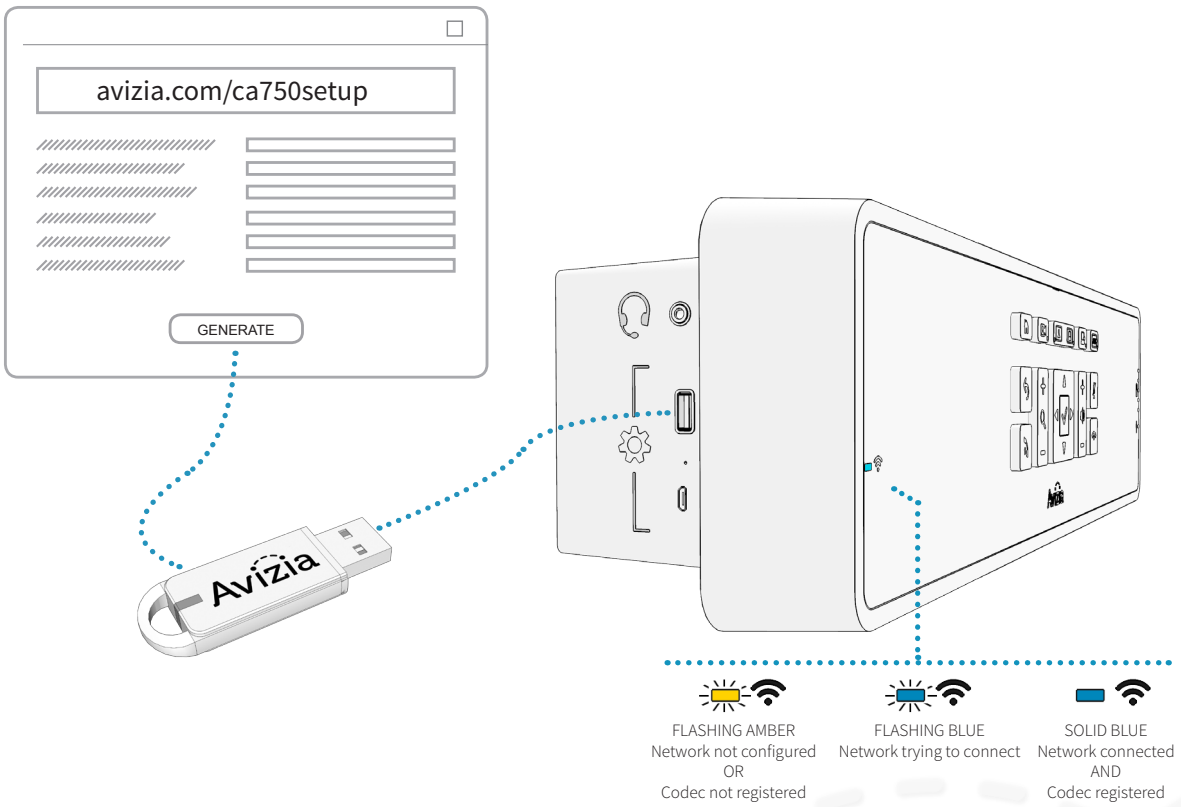
The default mode for the CA750 is Single-Client (SC) mode. This provides two dedicated Wi-Fi radios for the Cisco SX20 codec and the cart CPU.

1. Use a computer web browser to navigate to: **avizia.com/ca750setup** and fill in the secure webform with the wireless network settings on which the cart is to be connected. Consult your network administrator for the appropriate wireless network settings.

2. Save the configuration file (**CA750CONFIG.TXT**) to the root directory on the included Avizia USB flash drive (a user-supplied flash drive may be used instead).

3. Insert the USB flash drive into the USB 2.0 port on the left side of the console. A message will appear on the display confirming drive detection. The system will begin its configuration routine and may take up to a minute before a message indicating successful configuration appears.

4. The Network LED on the console will be a solid blue when a network connection is detected and the codec is registered.



NOTE

This procedure does not configure the SX20 codec — separate codec configuration is required.

Please refer to the Cisco SX20 Quick Set Administrator Guide* for registering your codec:
http://j.mp/Cisco-SX20-Admin.

Using the system

- Adjusting the system height
  - Raising the work surface
  - Lowering the work surface
- Adjusting the second display
- Controlling the camera
  - Camera controls
  - Selfview
- Controlling volume and microphone
  - Adjusting the speaker volume
  - Turning microphone on and off
- Navigating the menus
- Making a video call
  - Placing a call
- When in a video call
  - Using the PC
  - Presenting an auxiliary device
  - Presenting an electronic or digital stethoscope
  - Using headphones or a headset microphone
- Overview of typical display outputs

Adjusting the system height

Raising the work surface

Lift the height-adjustment arm while gently assisting the work surface to the desired height.

Lowering the work surface

Lift the height-adjust arm and firmly lower the surface to the desired height.

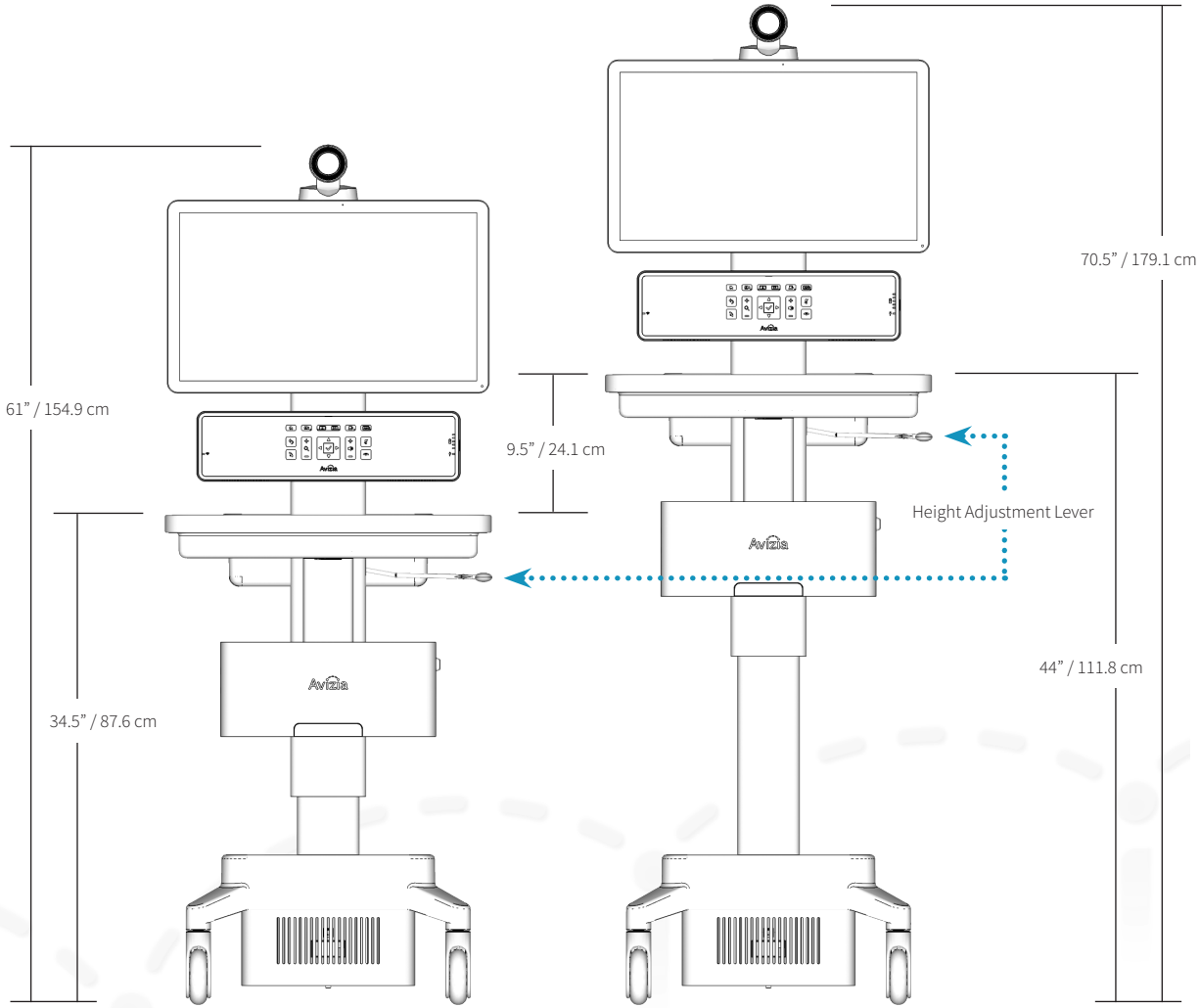
NOTE You may need to apply some extra pressure to the work surface as you lower the cart.

Lower before transporting

For your safety and to protect the CA750, fully lower the work surface before transporting the system. Pushing or pulling the system with any part of the system other than its handle may result in damage to the system.

Traversing thresholds and obstacles on the ground

Use the handle to PULL the system safely across thresholds, cords, cables, and other potential obstacles on the ground. Always fully lower the work surface before transporting the system.



Adjusting the second display

The optional Display Arm for a second display can be adjust laterally, vertically, and can tilt the display for optimal viewing from the front, sides, or rear of the cart.

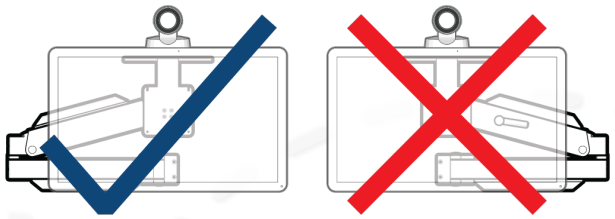
NOTE The provided hex wrenches can be used to adjust the tension on the arm at multiple points.

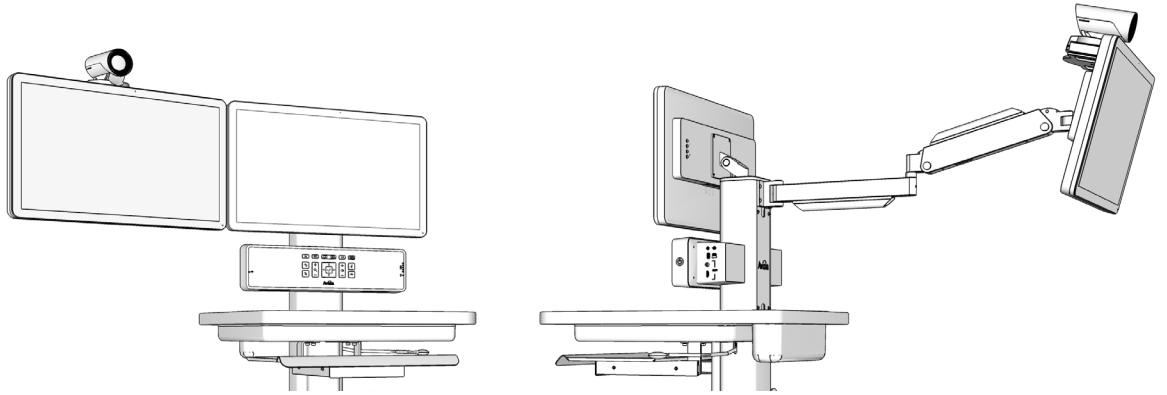
The vertical position is maintained by using the adjustment handle on the upper portion of the arm.

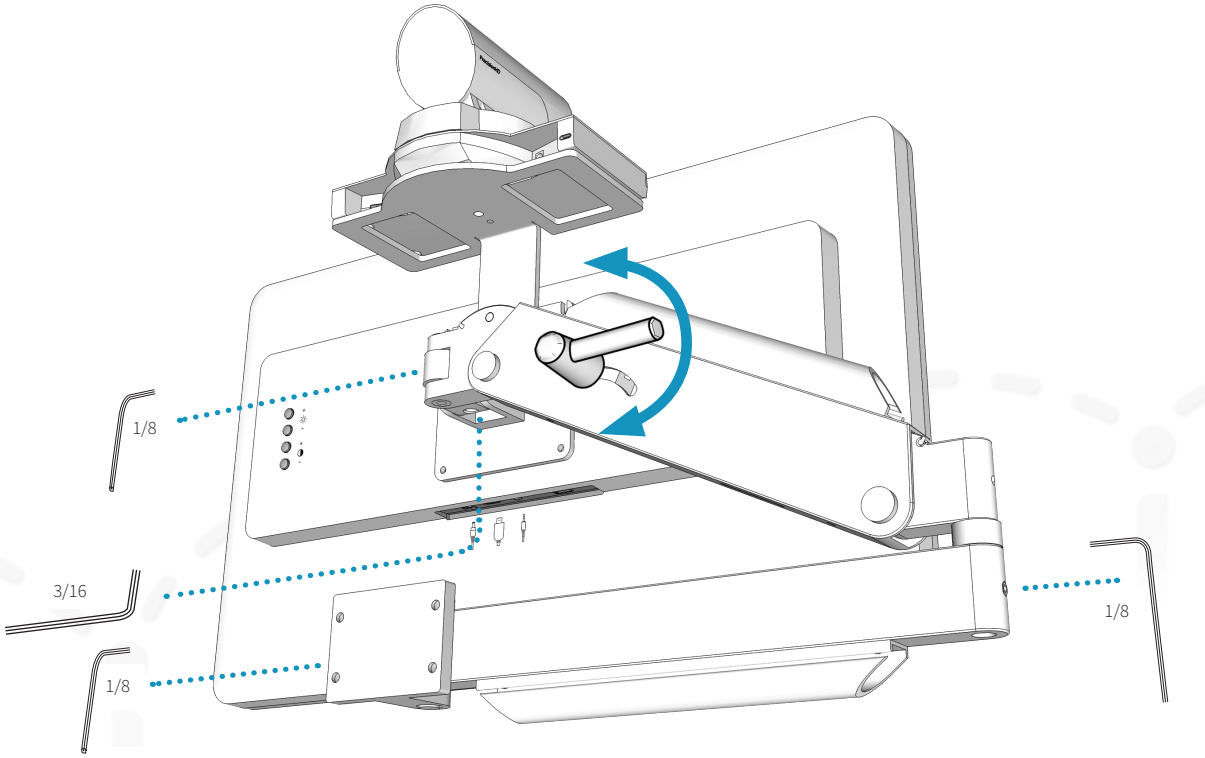
WARNING: Do not over-tighten but provide sufficient tension to each pivot joint so as to prevent unintended movement of the display, or the pinching fingers or cables.

When you collapse the display arm to reposition the second display closer to the cart, or to transport the cart to another location, ensure that the arm folds to the left of the display as you are facing the back of the cart.

This is to prevent damage to cables running along the arm.







Controlling the camera

Camera controls

Initiate CAMERA CONTROL by pressing the DIRECTIONAL PAD to pan and tilt the camera. Use the ZOOM buttons to adjust the camera's zoom level.

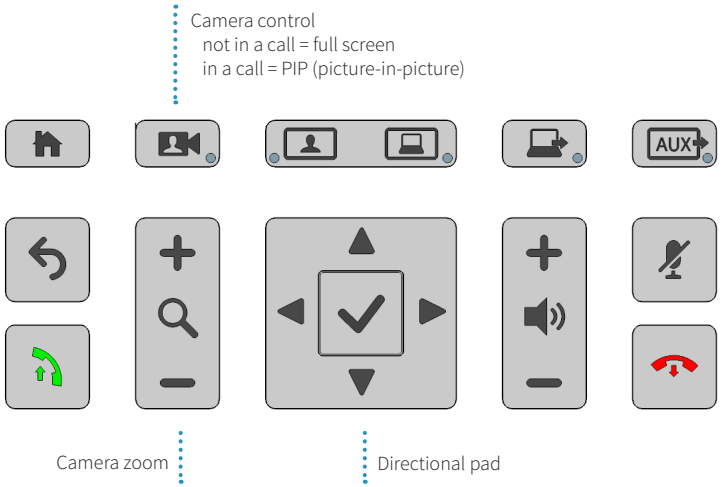
When you have finished adjusting the camera, select the source you want to see on the display: Selfview, PC, or AUX. If no button is pressed for approximately 10 seconds, the system will default back to the HOME view (codec Video Mode).

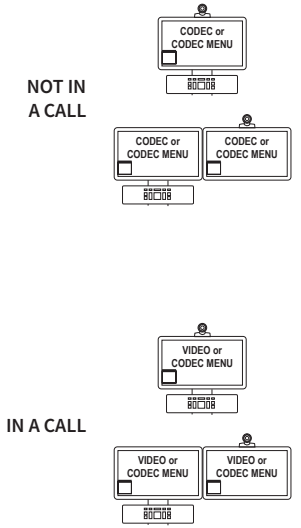
Selfview

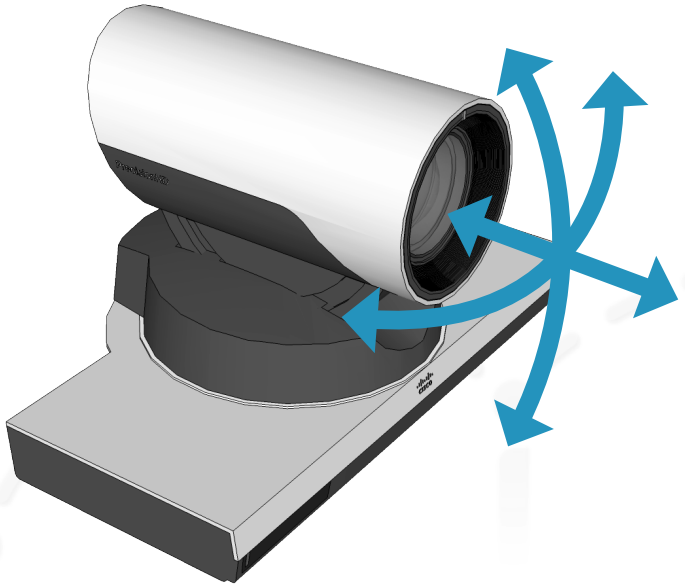
Selfview is the image remote participants will see of you — what is seen from your main camera.

Press CAMERA CONTROL on the system console to see your Selfview. You can adjust the camera's position and zoom with the Directional pad. The user-initiated selfview does not timeout.

NOTE When in a call, pressing CAMERA CONTROL will present your camera view as a PIP (Picture-in-Picture) at the lower right of the display.







Controlling volume and microphone

The system microphone is located on the front of the display and is extremely sensitive. Do not block or cover the microphone.

The system automatically manages echo cancellation.

The system speakers are located at the bottom of the system console. This is to ensure that the console is protected from foreign objects, dust, or liquids.

Adjusting the speaker volume

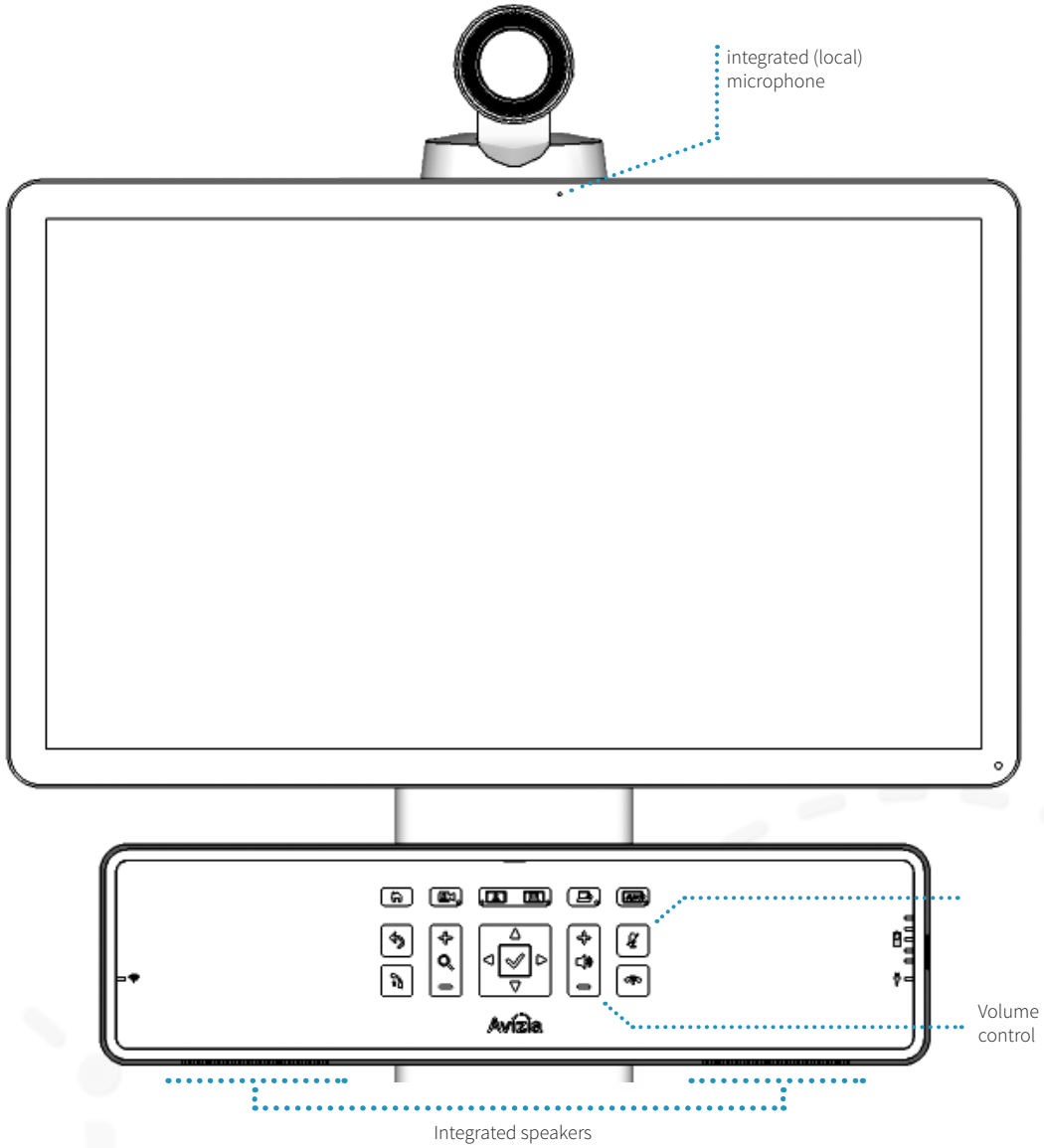
To adjust the volume, use the VOLUME CONTROL buttons on the console.

Turning microphone on and off

To mute your microphone, press (Mute) to prevent remote participants from hearing you. Press again to toggle the mic back on.

NOTE

Pressing (Mute) shuts off the internal (local) microphone only; all connected audio sources, such as a digital stethoscope or laptop audio, will continue to be heard during a call.

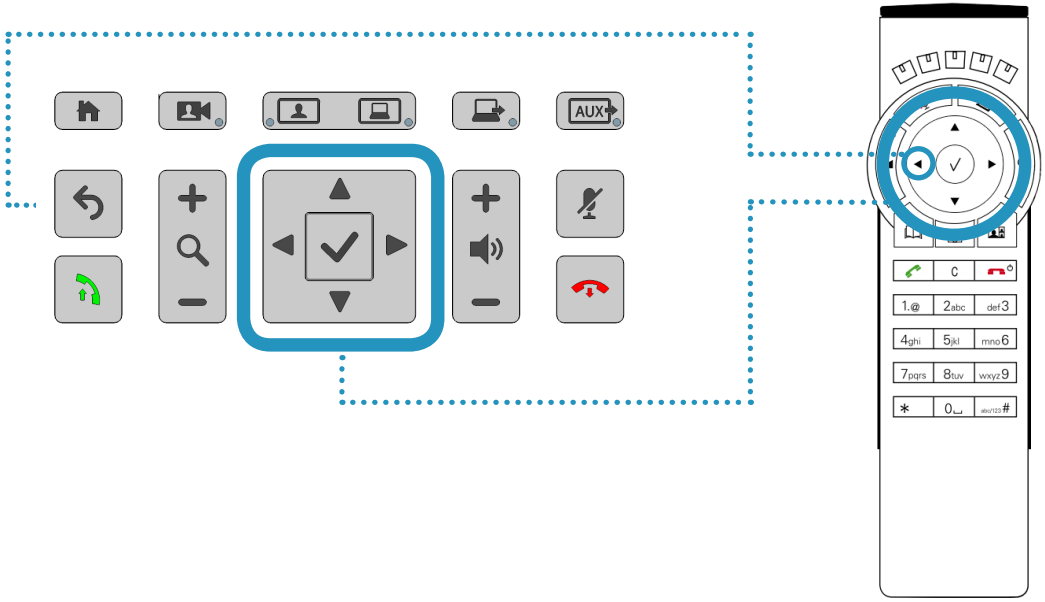


Navigating the menus

The DIRECTIONAL BUTTONS on the CONSOLE provide navigational control when accessing the system menus. The accompanying remote control may also be used to navigate and control the system with its corresponding buttons.

Refer to the Cisco codec documentation for detailed information on advanced codec functionality, menu navigation, and using the remote control:

http://cisco.com/go/sx-docs

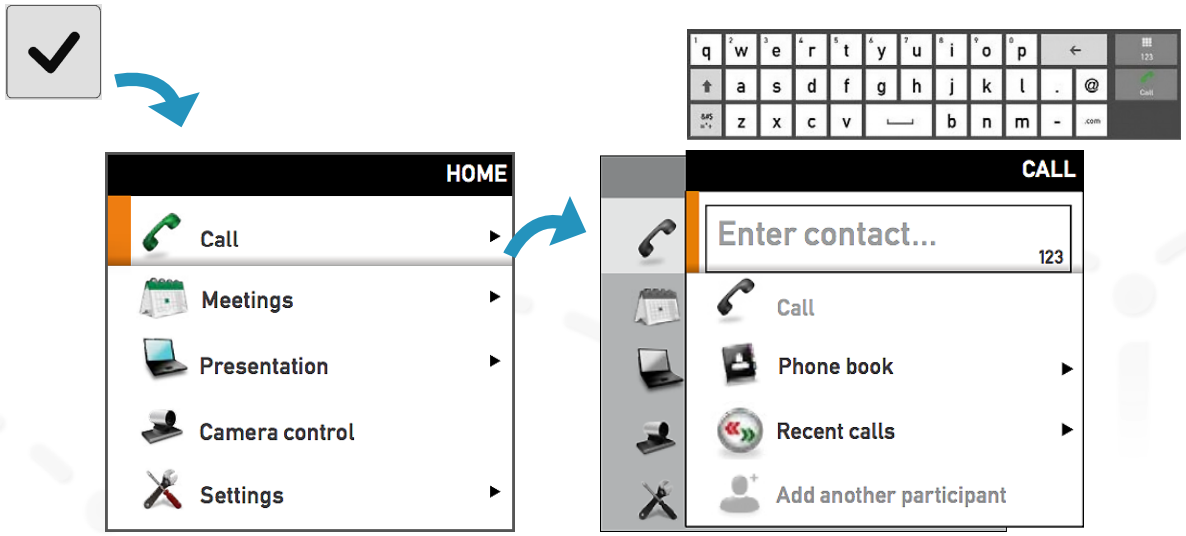


1. To show the system menu, press ✓ (OK) at the center of the directional pad.
2. Use the arrow buttons to navigate through the menu structure.

   NOTE If a menu item shows an arrow, selecting RIGHT will navigate to the next menu level.

   To “go back” in the menu structure, press LEFT or ↩ (Back).
3. To type, use the onscreen keyboard or the keypad on the remote. Use the directional arrows to move to the appropriate letter, number, or symbol. Press ✓ (OK) to select the desired character.
4. To quickly exit the menu structure, press ☎ (Disconnect).

NOTE When navigating the menu structure while you are in a call, pressing ☎ will not disconnect a call. Exit the menu system and then press ☎ to disconnect a call.



Making a video call

Press ✓ (OK) to bring up the Main Menu and select CALL for options to enter a contact number or address, select a phone book entry, or select from the Recent calls list.

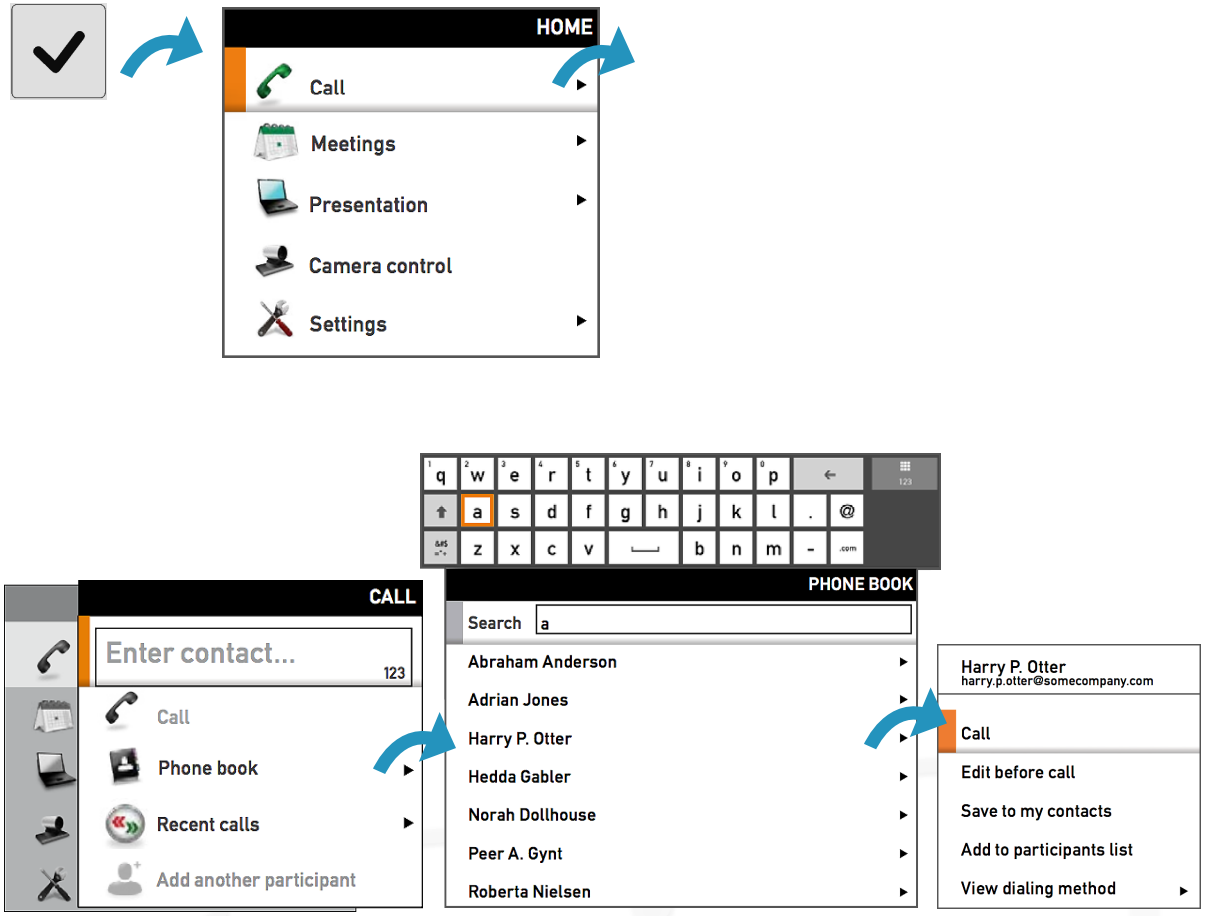
Placing a call

Enter or select the contact to call and press (Connect) to place a call.

Each contact can be edited, added to personal contact lists, or added as participants to a Multisite call (optional feature). This is done by selecting a contact entry and pressing RIGHT to see these additional entry options, as seen in the images on the right.

Calling options

- **Specifying name, number, or address:** You can place a call by entering the contact number or address directly.
- **Using the phone book:** Navigate to Phone book by going to the Call menu option on the main menu. From the phone book, you can search, scroll through the directory, or create a directory entry, and then select the contact you wish to call.
- **Use the Recent calls list:** A list of recent calls can be accessed, from the Call menu option on the main menu, as a streamlined alternative to manually entering the contact information or using the phone book directory. **TIP:** When not in a call and not in the menu system, pressing (Connect) will take you directly to the Recent calls list.



When in a video call

Using the PC

The PC drawer option provides space to house an Ultra Small Form Factor (USFF) PC for integration with the CA750. The system is designed to allow the user to operate the computer and cart as a workstation, showing the computer desktop on the front display. The PC can also be shared to remote participants.

Workstation mode

To use the user-integrated PC, press (Workstation mode) to show the PC desktop on the cart's display.

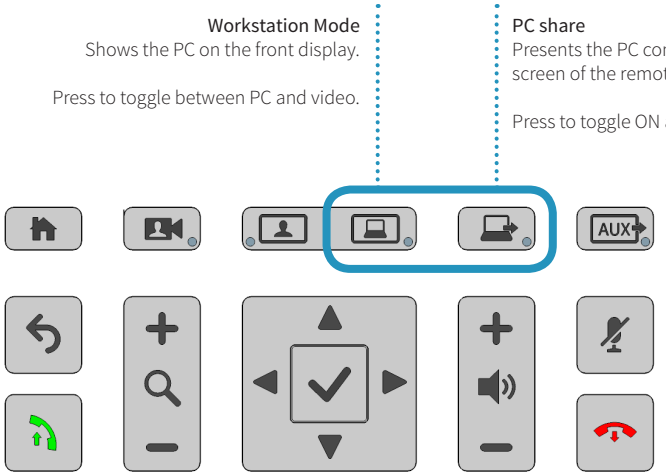
NOTE On a dual display system, the PC will be seen on the cart's front display only. The second display will show video

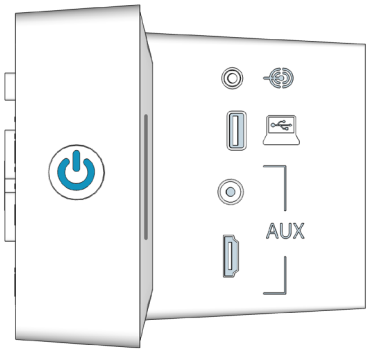
PC share

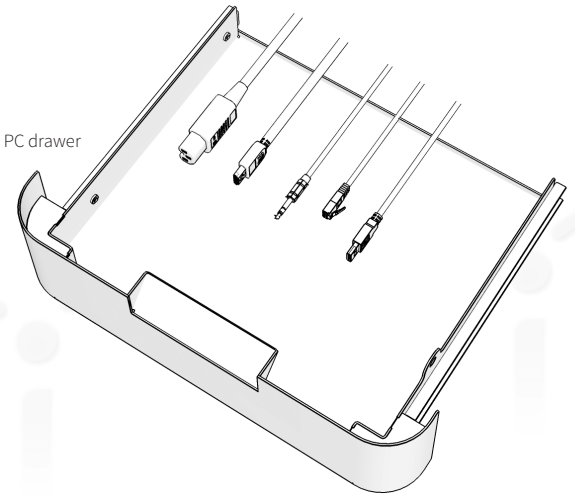
Press (PC share) present the PC during a video call. The remote participants can now see the contents of your PC you are sharing.

NOTE On a dual display system, the PC will also be seen on the cart's front display only.

NOTE The PC HDMI connection does not support audio. To enable PC audio use the 3.5mm connector.







When in a video call

Presenting an auxiliary device

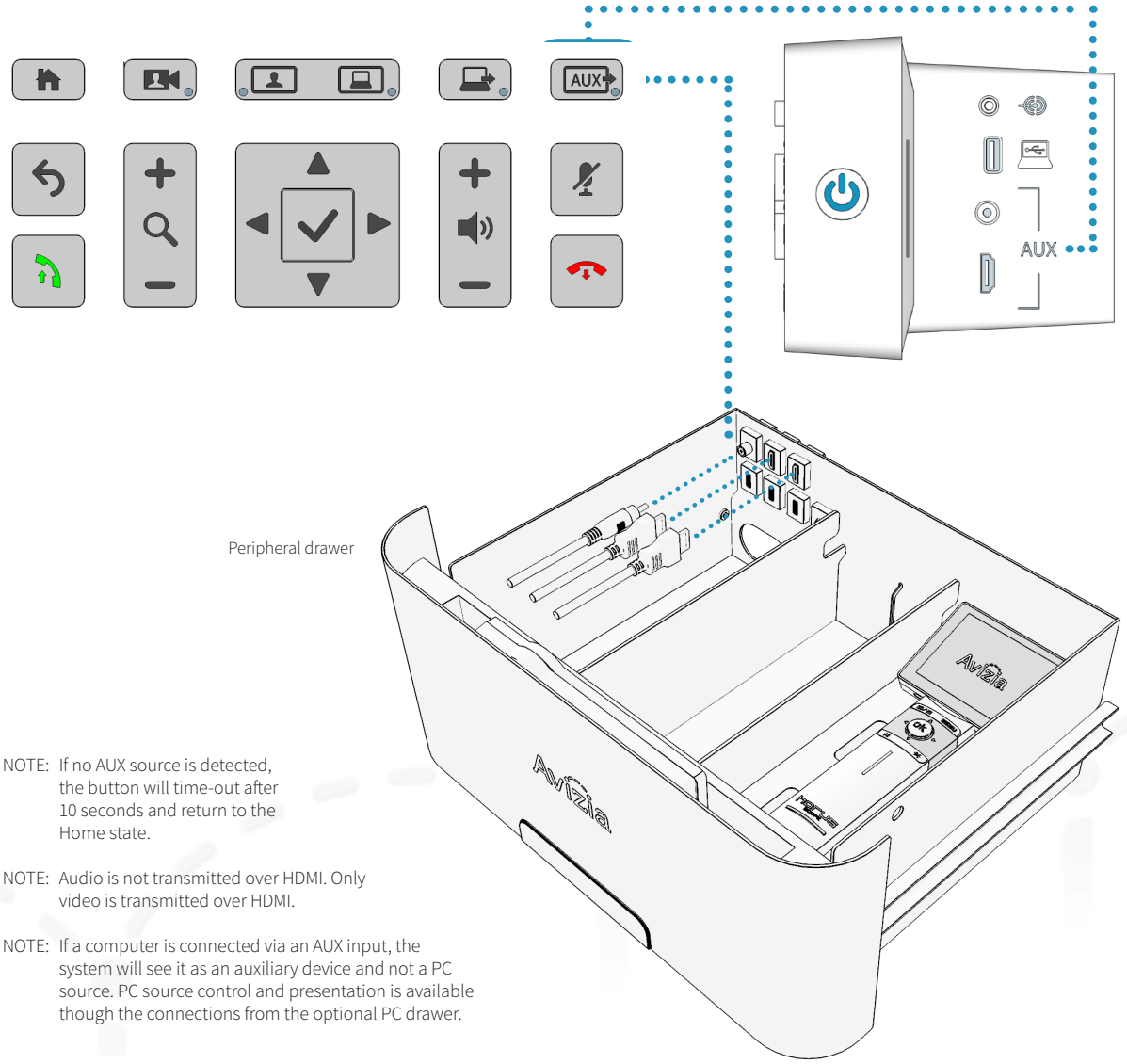
Optional AV devices for transmitting images and video can be connected to the CA750. These auxiliary sources can be connected simultaneously via the console and the peripheral drawer, however only one source may be presented at a time.

1. Connect auxiliary devices to the HDMI inputs and/or Composite inputs. Any device that provides video output and is connected to the system's HDMI or composite inputs can be displayed on the system: laptop computer, digital scope, examination camera, video feed from ultrasound, etc..
2. Press AUX (AUX) to present the contents of your device to the call participants. The system will detect the first active auxiliary source and the blue light on the button will indicate that the AUX source is presenting.
3. Press again to toggle through the connected devices.

   Ensure the AUX source(s) are appropriately powered and turned on to be viewed as the AUX source when selected.

NOTE There are five auxiliary inputs on the CA750 which toggle through a prioritization schedule:

1. Composite (SD) on console
2. HDMI (HD) on console
3. Composite (SD) in drawer
4. HDMI (HD) in drawer
5. HDMI (HD) in drawer
6. Default view (Home)



NOTE: If no AUX source is detected, the button will time-out after 10 seconds and return to the Home state.

NOTE: Audio is not transmitted over HDMI. Only video is transmitted over HDMI.

NOTE: If a computer is connected via an AUX input, the system will see it as an auxiliary device and not a PC source. PC source control and presentation is available though the connections from the optional PC drawer.

When in a video call

Presenting an electronic or digital stethoscope

The optional E-Scope II and other electronic or digital stethoscopes can be connected to the CA750 to transmit the corresponding audio to remote participants.

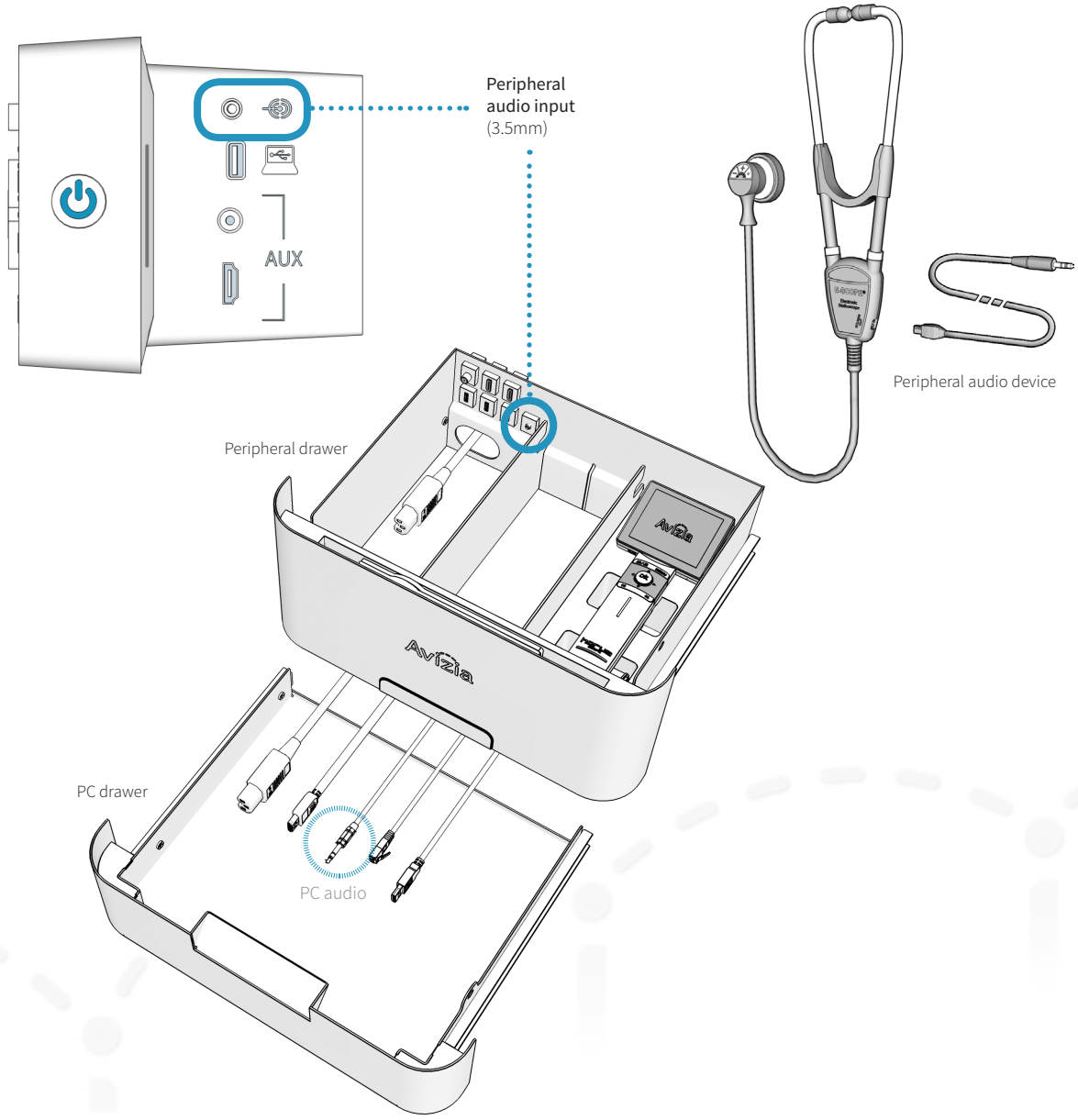
Connect the 3.5mm cable from the stethoscope or audio device to the 3.5mm audio input on the system. The audio from the device is now mixed into the video call.

NOTE There are three audio inputs on the CA750. Each connected audio source will be mixed into the video call.

1. Peripheral Audio Input (console)
2. Peripheral Audio Input (drawer)
3. PC Audio Input (with PC drawer option)

Unplug any other audio connection(s) to present the desired audio without disruption from other sources.

NOTE The CA750 can experience audio distortions due to network latency, software/hardware malfunction, insufficient bandwidth, or for other reasons.



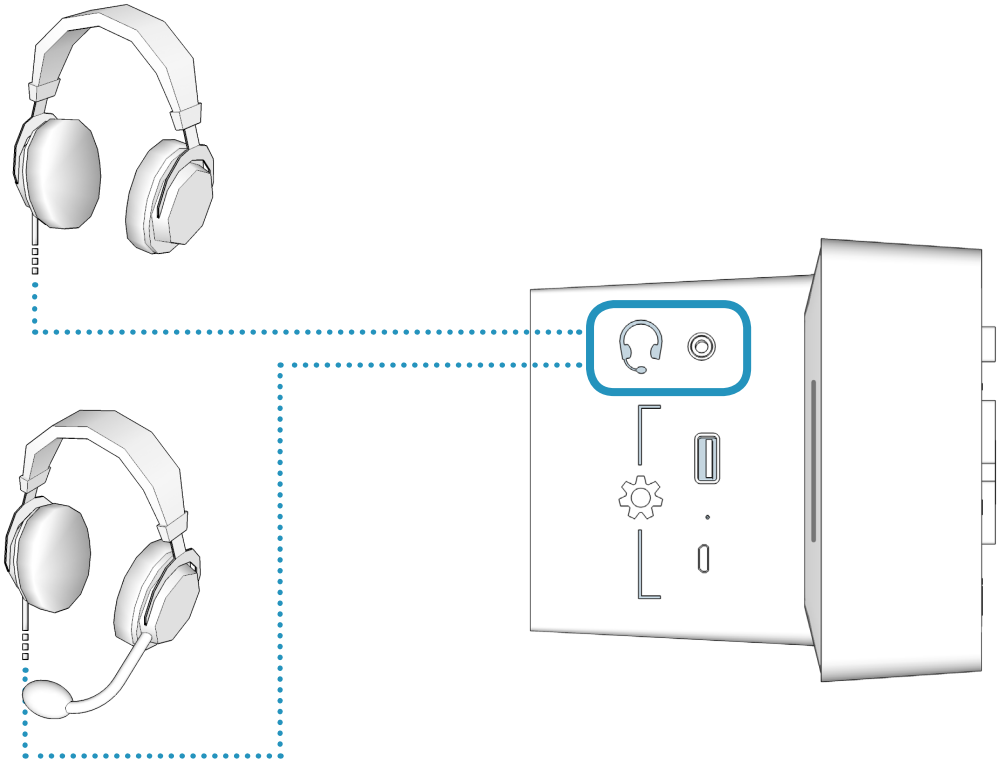
When in a video call

Using headphones or a head-set microphone

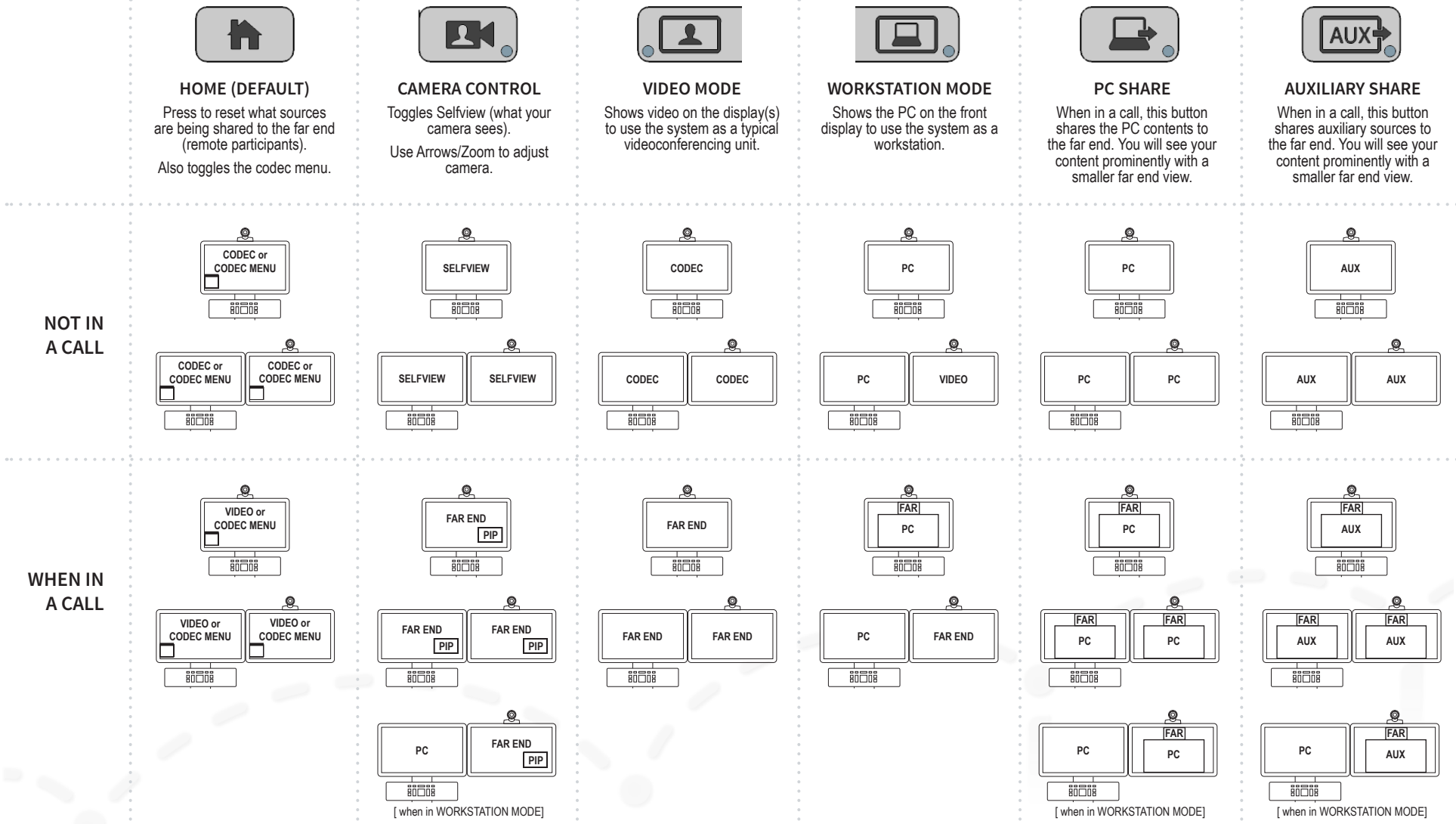
When in a call and privacy is desired, a standard 3.5mm headphone or a headset with an integrated microphone can be plugged into the CONSOLE to provide audio out-put.

When plugged into the Console, all audio will be directed through the headphones and speaker audio out of the Console will be turned off.

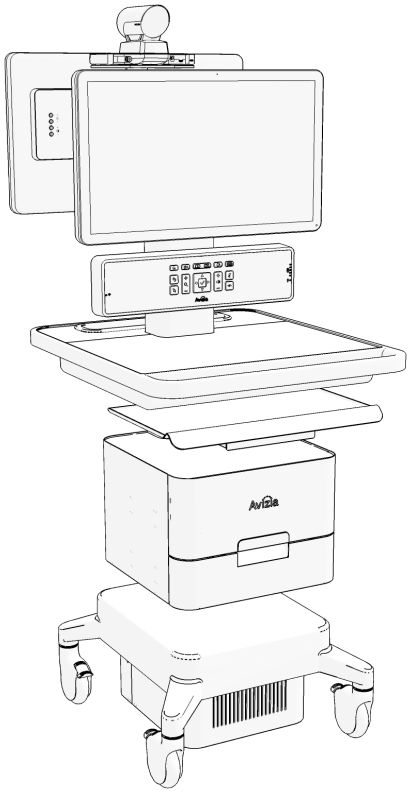
If you are using a headset with a microphone then the integrated system mics will be muted and only the headset microphone will be mixed into the call.



Overview of typical display outputs



Maintaining the system



- Displaying system information
- Cleaning and maintenance guidelines
- Battery guidelines
- Installing updates
- Factory defaulting the system
- Storing the system

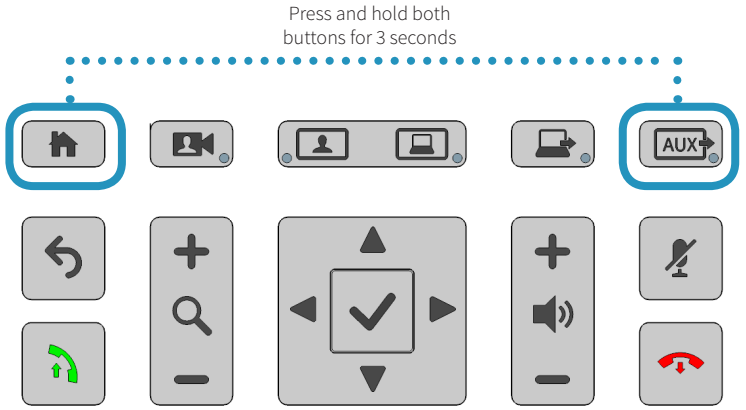
Displaying system information

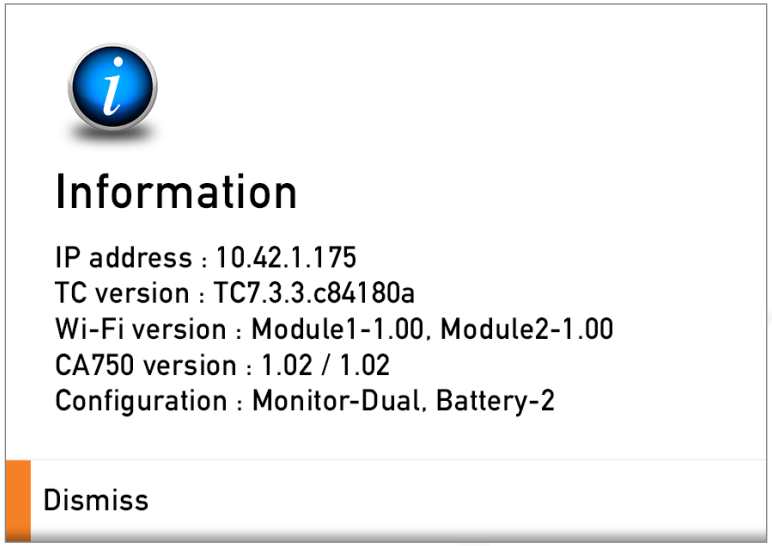
There a several Console button combinations you can perform to provide specific information pertaining to your CA750 cart. Press and hold any of the following combinations for about three seconds to view the appropriate dialogue box. Press ✓ (OK) to close the information window.

System Information: Home + AUX

Wi-Fi Information: Home + Video Mode

Serial and MAC Addresses: Home + PC Share





Cleaning and maintenance guidelines

Cleaning the system

The surface materials of the CA750 are durable and easy to maintain. Follow the general cleaning guidelines, found to the right.

Maintaining the system

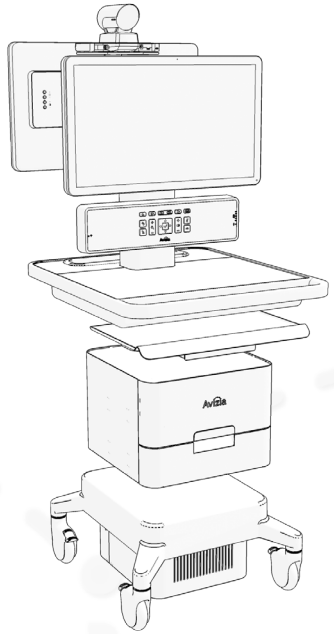
The CA750 is designed with minimal maintenance requirements. However, a yearly check on system fasteners and cables (screws, nuts, bolts, cables) will ensure that the CA750 is in good operating order.

NOTE

Avizia will make available, on request, such circuit diagrams, component part lists, descriptions, calibration instructions or other information which will assist appropriately qualified technical personnel to repair those parts of the equipment which are classified by Avizia as field repairable.

LCD monitor and Camera

- Always disconnect your monitor's power from the system before cleaning. Clean the camera and LCD monitor surface with a lint-free, non-abrasive cloth. Avoid using any liquid, aerosol or glass cleaners.
- Slots and openings on the back or top of the cabinet are for ventilation. They must not be blocked or covered. Your monitor should never be placed near or over a radiator or heat source, or in a built-in installation unless proper ventilation is provided.
- Never push objects or spill liquid of any kind into this product.



System

- All surfaces — painted and plastic cart components — will withstand cleaning by commonly available multi-purpose surface cleaners.
- To avoid risk of electric shock, do not expose electrical components to water, cleaning solutions or other potentially corrosive liquids or substances.
- Do not immerse system or system components in liquid or allow liquids to flow into the cart. Wipe all cleaners off surface immediately using a damp cloth. Thoroughly dry surface after cleaning.
- Do not use flammable cleaners on cart surfaces due to close proximity of electrical power and equipment.
- Never use steel wool or other abrasive materials that will damage the surface finish.
- Do not use strong solvents such as trichloroethylene and acetone. These solvents will damage the surface finish.
- It is recommended that any cleaning solution be tested on a small, inconspicuous area to ensure surface is not harmed.

Battery guidelines

This system contains no user-serviceable parts.

Remote control

Batteries for the Remote Control are Long Life Alkaline batteries; please follow guidelines on the packing material for handling and disposal of the batteries.

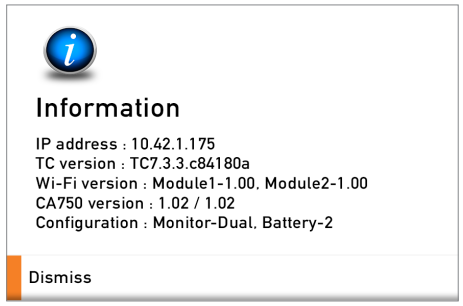
CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO APPROPRIATE LOCAL REGULATIONS.

Rechargeable system battery

The system enclosed rechargeable battery (LiFePo) in this product is non-user replaceable and should be removed by a qualified service technician only.

Installing updates

Identify what versions of firmware are currently installed on your system by simultaneously pressing [⌂] + [AUX] for three seconds. This will bring up information about system firmware versions:

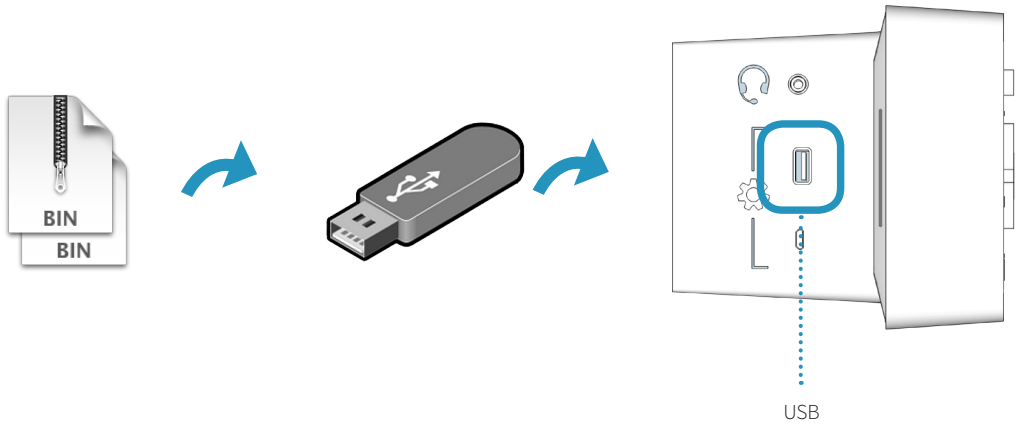


To update the firmware for the CA750:

1. Download the appropriate firmware file(s) to your computer from http://avizia.com/firmware.
2. Place the file(s) into the ROOT directory of a USB thumb/flash drive. Note that the USB drive must be formatted as FAT or FAT32.
3. Ensure the CA750 is powered on and in an idle state (not in a call). Insert the USB drive into the USB port on the side of system console and wait 5-10 seconds for an update prompt.
4. Use the directional pad to select YES and follow the onscreen prompts to update the firmware item(s).

   NOTE The update process may take a little over two minutes to complete.

5. You can remove the USB drive once the system has rebooted and you see the default codec screen.



Factory defaulting the system

Should a need arise to remove ALL system configuration settings, press and hold the following buttons at the same time for 5 seconds:

BACK + MAKE CALL + MUTE + DISCONNECT

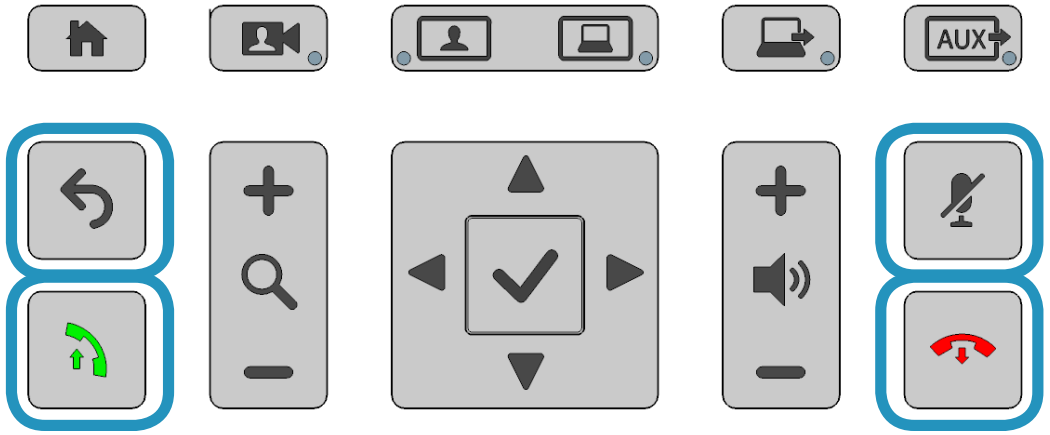
The source selection LEDs will light up one by one and blink three times before the entire system reboots.

Once the system has fully booted up, it is ready for setup and configuration.

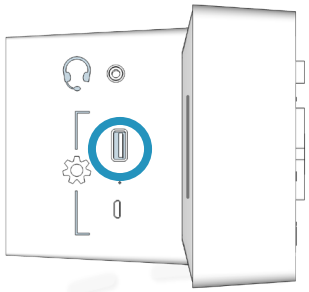
For a wired network connection only: Do not forget you must manually register the Cisco codec to the CUCM and ensure that the SERIAL PORT setting is set to OFF.

The Wi-Fi configurations can be reset by pressing the following for about three seconds:

BACK + MIC MUTE



To power-cycle the cart, use the end of a paperclip or something similar, and insert into the Pinhole on the side of the Console.



WARNING: Ensure that any connected devices requiring power is turned off before power-cycling the system. All connected devices requiring power will lose power when the system is power-cycled.

Storing the system

Short-term storage

If the system is to be stored for a relatively short period of time, we recommend that the system be plugged in to an electrical outlet during storage. This ensures that the internal battery maintains a full charge and is ready when needed.

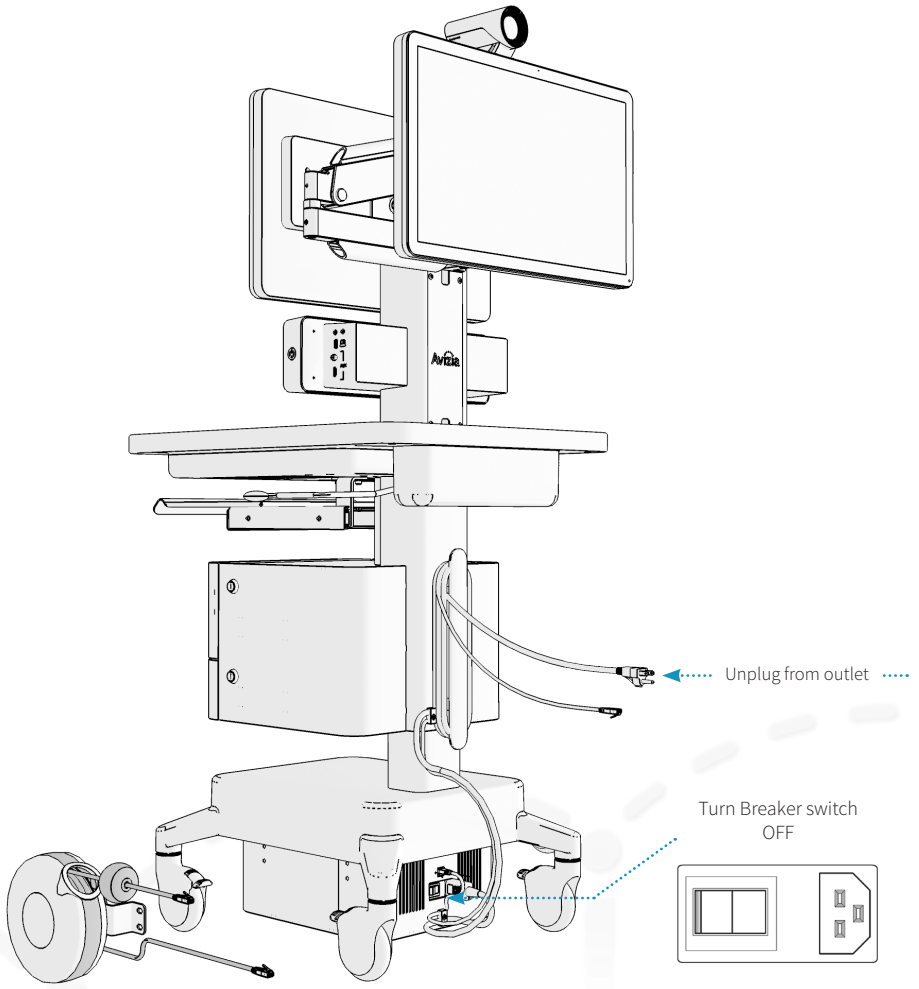
Long-term storage

If the system is to be stored for an extended period of time, we recommend you place the system into “deep sleep” mode:

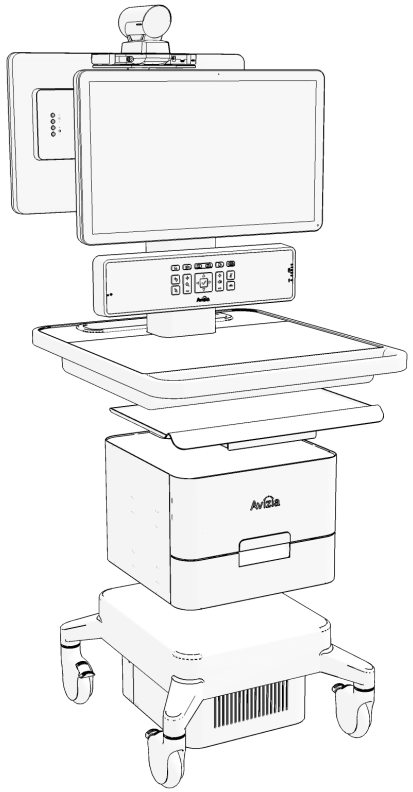
1. Disconnect the system from AC power:
   - Unplug from electrical outlet
   - Place the Breaker switch at the base of the cart to the OFF position.
2. Press the (Home) + (Disconnect) buttons simultaneously for about 3 seconds until the system turns off. This will prevent the battery from keeping the system powered.
3. Wrap power cord on the cable wrap.
4. Secure or appropriately store peripheral devices and cables.
5. Store the system in a cool, dry environment.

NOTE

The battery will lose some charge if stored for an extended period of time. Ensure the battery is sufficiently recharged before running the system on battery power.



Troubleshooting



I can't turn the system on.

- Make sure the system breaker switch is in the ON position. This switch is by power inlet connector found at the base of the cart. Then, press the Power button on the right side of the console until the button illuminates blue.
- Ensure the power cord is properly connected to the system and to the AC outlet. You should see the LED power indicator on the front of the console illuminate blue.

Why is the screen black?

- Ensure the system is powered on and the display's power cord and HDMI cable are properly inserted. Press the display's power button to turn on.
- The display setting may have been changed or set incorrectly:
  1. Ensure the display's HDMI cable is properly inserted.
  2. Press and hold the system power button on the side of the console until the blue LED turns off.
  3. Wait a few seconds and turn the system back on. The HDMI setting on the display should be automatically reset and no longer show a black screen.
- Pressing the PC or AUX source buttons when there are no devices connected to the corresponding connections will result in a black screen. The PC and AUX sources will time out after 10 seconds and return to the Main camera (default) view.

I can't make a video call.

- Ensure the system has network connectivity:
  - check Ethernet connection
  - check wireless connection and/or the wireless configurations
- Make sure the system codec's network configurations are properly set and registered. Contact your network administrator or refer to the Cisco SX20 codec documentation at:
  http://cisco.com/go/sx-docs

When I try to show my laptop or other device I get a black screen.

- Check that the video cable from the laptop or device is in the appropriate connection on the console.
- Make sure the laptop display setting is appropriately configured to mirror or extend to another display.

Product Specifications

AVZ-CA750-1-IP40
Avizia Clinical Assistant 750 - Single Screen with Drawer Module - includes integrated SX20 Codec, PHD camera (8X), single 24" HD LED monitors, peripheral device drawer with integrated power and inputs, foam drawer insert for Horus Scope, remote control, premium resolution software option, 4-hour battery, wired networking and integrated Wi-Fi.

AVZ-CA750-2-IP40
Avizia Clinical Assistant 750 - Single Screen with PC Cabinet - includes integrated SX20 Codec, PHD camera (8X), single 24" HD LED monitors, PC Cabinet, peripheral device drawer with integrated power and inputs, foam drawer insert for Horus Scope, remote control, premium resolution software option, 4-hour battery, wired networking and integrated Wi-Fi.

AVZ-CA750-3-IP40
Avizia Clinical Assistant 750 - Dual Screen with PC Cabinet - includes integrated SX20 Codec, PHD camera (8X), dual 24" HD LED monitors, PC Cabinet, peripheral device drawer with integrated power and inputs, foam drawer insert for Horus Scope, remote control, premium resolution and dual display software options, 4-hour battery, wired networking and integrated Wi-Fi.

OPTIONS
- Dual display with articulating arm
- Additional 45 Ah Lithium Iron battery
- MultiSite for SX20 Codec
- Lockable PC cabinet
- Keyboard tray
- Retractable cable reels (power, Ethernet)

VIDEO
- Cisco SX20 codec with 8x Precision HD camera

DISPLAY
- 24" HD LCD (with integrated mic)
- 2nd 24" HD LCD (option)

CONTROL OPTIONS
- Button panel with call, menu, camera and content control
- Cisco IR remote (use is optional)

VIDEO INPUTS
- Three HDMI (fourth included in PC cabinet option)
- Two SD (composite)
- Four USB 3.0 routable to PC (three in peripheral drawer)

VIDEO OUTPUT
- One HD (internal HDMI for 2nd display option)

AUDIO INPUT
- Mic (integrated)
- Three 3.5mm

AUDIO OUTPUT
- Speakers (integrated)
- One 3.5mm (integrated headphone and mic jack)

NETWORK
- Wired Ethernet (10/100/1000 Mbps)
- Integrated Wireless (option) (2.4 GHz and 5 GHz, 802.11 a/b/g/n, WEP/WPA/WPA2, 802.11x LEAP, PEAP, TTLS, FAST)
- Will support client certificate loading in the future.

POWER SHARING
- Two IEC-C13 120VAC connections (third included in PC cabinet option)
- Four USB 3.0 (three in peripheral drawer)

STORAGE
- Lockable drawer (13"x 10"x5.25")
- Bin (13.25"x2.75"x2.75")
- Lockable PC cabinet (option) (13.25"x2.75"x2.75")

HEIGHT ADJUSTMENT
- 10" (24.5cm)

POWER
- 45 Ah Lithium Iron battery provides 3-4 hr. of power
- Additional 45 Ah Lithium Iron battery provides 6-8 hr. of power (option)

CLEANABILITY
- Edge-to-edge glass displays
- Anti-microbial work surfaces
- Downward facing speakers (no speaker grill on front)

PHYSICAL DIMENSIONS
- Width: 23" (58.5cm)
- Depth: 27" (68.6cm)
- Height: 60-70 in. (152.4-177.8 cm)
- Weight:
  - 180 lbs. (without options)
  - 215 lbs. (with 2nd display and PC cabinet)
  - 230 lbs. (with 2nd display, PC cabinet, and 2nd battery)

OPERATING TEMPERATURE AND HUMIDITY
- 50 to 95°F (10 to 35°C) ambient temperature
- 20 to 90% relative humidity (RH)
- Atmospheric pressure: 700 to 1060 hPa

STORAGE AND TRANSPORT TEMPERATURE
- 14 to 140°F (-10 to 40°C) at RH 10 to 80% (noncondensing) at RH 20 to 90%
- Atmospheric pressure: 700 to 1060 hPa

APPROVALS AND COMPLIANCE
- ANSI/AAMI 60601-1-3rd edition
- CAN/CSA-C22.2 No. 60601-1:2014
- Compliance with FCC 47 CFR Part 15 Class A
- FDA Class I Medical Device Data System (MDDS)
- Medical Device Directive EN 60601-1 Class I Equipment

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WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

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Avizia

Exhibit K

American Well 760 Cart

American Well®

At a Glance

Save patients' lives by providing timely care in life-threatening situations

The **American Well 760** telemedicine cart is an FDA Class I medical device designed to bring remote specialists to support acute care teams on-site. The cart's intuitive interface allows for immediate use by medical teams in acute situations and its superior camera supports the remote physician in quickly diagnosing the patient and recommending a treatment.

THE 760 CART FEATURES:

- **New Cisco Webex Codec Plus**
- **Easier controls with the Touch 10 panel**
- **Higher performance camera with 20x zoom**

TELEMEDICINE CART

American Well 760

Extensions

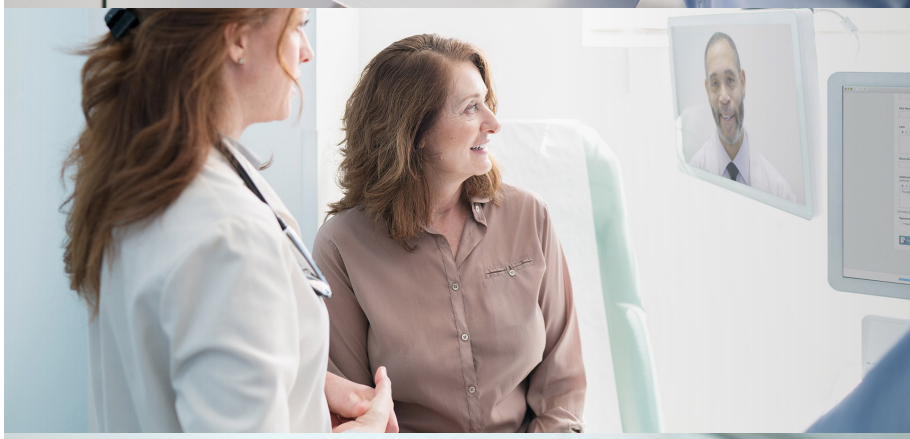
Grow your telehealth program – Launch new telehealth services by adding new workflows to the device at any time.

Designed around you – Run your telehealth programs on American Well's telehealth platform or within an existing Cisco infrastructure.

Superior experience for remote providers – Full control of the camera and 20x zoom improve the remote providers' ability to diagnose the patient with the same precision as in-person care.

Intuitive touchscreen interface – An improved touchscreen user interface enables simple dialing and peripheral control.

Worry-free Fleet Monitoring – Ensure your telehealth solution is up and running at all times by tracking the status of your devices, enabling auto-alerts and proactively responding to support needs. Remote device management service available to monitor your carts 24/7/365.



Features

SAFETY

- FDA Class I Medical Device Data System (MDDS)
- ANSI/AAMI 60601-1-3rd edition
- CAN/CSA-C22.2 No. 60601-1:2014
- Compliance with FCC 47 CFR Part 15 Class A
- Medical Device Directive EN 60601-1 Class I Equipment

DIMENSIONS

- 70.5" (179 cm) Max. Height (adjustable)
- 23" (58 cm) Width
- 27" (69 cm) Depth

CODEC & CAMERA

- Cisco Webex Codec Plus (CE9)
- Pan-tilt-zoom camera with far end camera control
- Precision 60 20x zoom camera Increased image clarity with f/2.8 lens

DISPLAY

- 24" (61 cm) Edge-to-Edge Glass LCD Display (with integrated microphone*)
- (option) 2nd 24" (61 cm) Edge-to-Edge Glass LCD Display (with integrated microphone)

CONTROL OPTIONS

- Touch 10 panel

VIDEO INPUTS

- 3 – HDMI (4 with PC cabinet option)
- 2 – SD (composite)
- 4 – USB 3.0 (3 in drawer)

VIDEO OUTPUTS

- 1 – HD (HDMI) Audio Input

AUDIO INPUT

- 1 - Mic (integrated, 2 with 2nd display option) 3 – 3.5 mm

AUDIO OUTPUT

- Downward Facing Integrated Speakers
- 1 – 3.5mm

NETWORK

- Wired (10/100/1000 Mbps Gigabit Ethernet)
- Integrated Wireless (2.4 GHz and 5 GHz, 802.11 a/b/g/n, WEP/WPA/WPA2, 802.11x LEAP, PEAP, TTLS, FAST)

POWER

- 45 Ah Lithium Iron battery provides 4 hrs
- 2nd 45 Ah Lithium Iron battery for 8 hr. (option)

POWER SHARING

- 2 – IEC-C13 120V AC connections (3rd with PC cabinet option)
- 4 – USB 3.0 (3 in drawer)

STORAGE

- Lockable drawer (13" x 10" x 5.25") (33 cm x 25.5 cm x 10.3 cm)
- Bin (13.75" x 2.75" x 5") (34.9 cm x 7 cm x 12.7 cm)
- Lockable PC cabinet (option) (13" x 11.75" x 3.25") (33 cm x 29.8 cm x 8.2 cm)

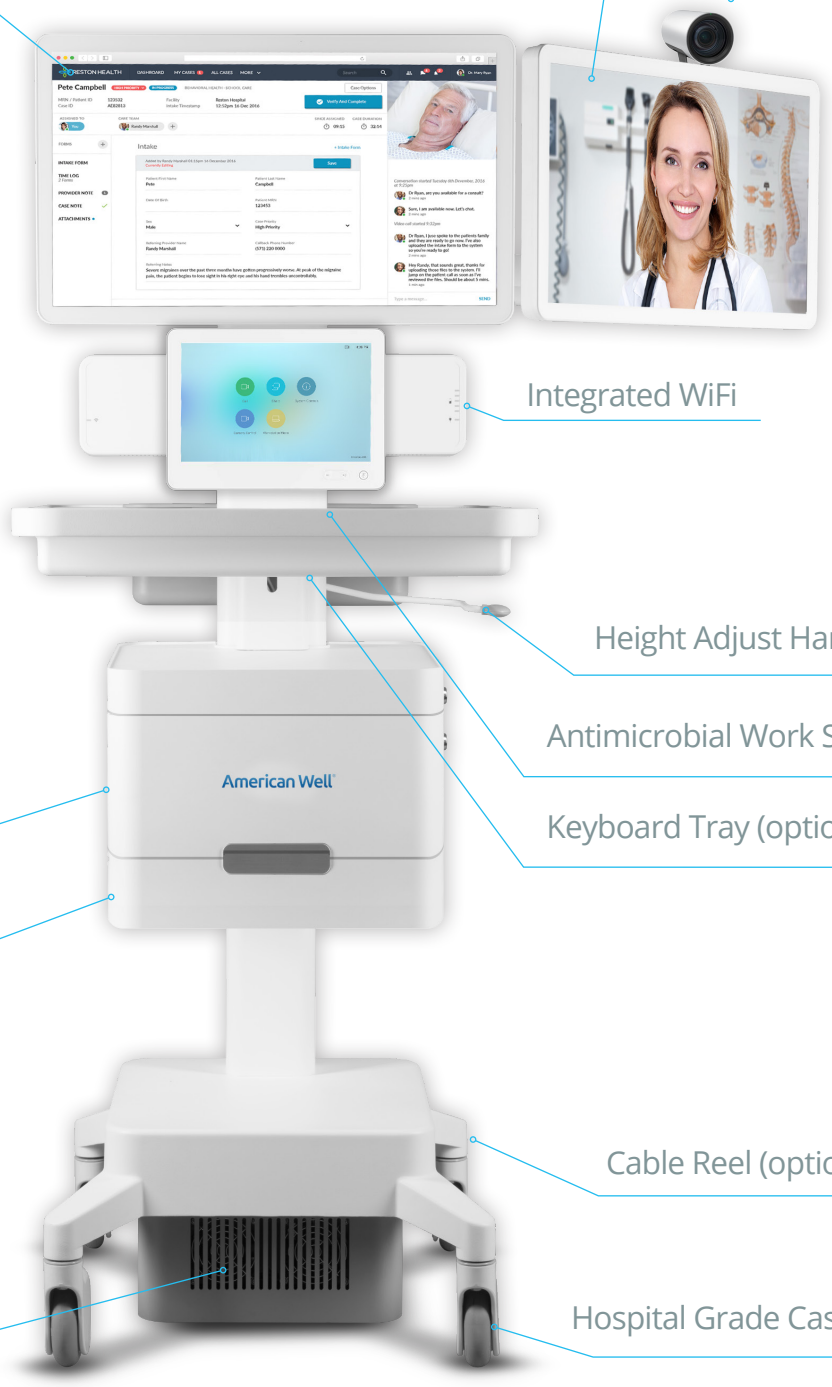
TELEMEDICINE CART

American Well 760

Integrated 2nd Display with Articulating Arm (optional)

HD Camera

24” Display



Integrated WiFi

Height Adjust Handle

Antimicrobial Work Surface

Keyboard Tray (optional)

Peripherals Drawer

PC Cabinet (optional)

Cable Reel (optional)

Lithium Iron Battery with 4HR Charge (optional 8hr Battery)

Hospital Grade Casters

American Well®

WHAT WE DO

American Well is a leading telehealth platform in the United States and globally, connecting and enabling providers, insurers, patients, and innovators to deliver greater access to more affordable, higher quality care.

American Well believes that digital care delivery will transform healthcare. The Company offers a single, comprehensive platform to support all telehealth needs from urgent to acute and post-acute care, as well as chronic care management and healthy living. With over a decade of experience, American Well powers telehealth solutions for over 130 health systems comprised of 2,000 hospitals and 55 health plan partners with over 7,000 employers, covering over 150 million lives.

For more information, please visit AmericanWell.com

Exhibit L

TELEMEDICINE CART

American Well C250

Thousands of Providers,
Unlimited Use Cases.
All in One Cart.

American Well®

SUPERIOR PROVIDER EXPERIENCE

This purpose-built cart comes pre-configured and will automatically display your active workflows so you can get started right away. Providers can start a telehealth consult with one touch and peripheral images are seamlessly integrated into the telehealth consult. Remote providers also benefit from having full control of the camera and 20x zoom to diagnose patients with the same precision as in-person care.

- Purpose-built operating system
- One-touch consult
- Peripheral integration
- 20x zoom camera
- Remote camera control

EASY ACCESS TO THOUSANDS OF PROVIDERS

The American Well C250 cart connects you to not just your own providers, but to thousands of cloud providers in the Online Care Group or through ecosystem partners in The Exchange. The American Well software will look for available providers in the American Well provider network, dynamically route them to the cart and only display available providers on the cart's interface.

- Your own providers
- Online Care Group
- The Exchange
- Provider Service Organizations

WORRY-FREE FLEET MONITORING

Ensure your telehealth solution is up and running at all times by tracking the status of your devices, enabling auto-alerts and over-the-air updates, and proactively responding to support needs. 24/7/365 management service is available as an add-on option.

- Full system control
- Seamless OTA updates
- Remote monitoring

At a Glance

The **American Well C250** Telemedicine Cart is the first cart to connect you to the American Well provider network as well as to your own providers, giving you access to thousands of specialists on demand. This versatile cart supports every workflow, from patient triage to specialist consults, and is designed to help you scale your telehealth program.

BENEFITS

- **Access to American Well's provider network**
- **Start a telehealth consult with one touch**
- **Seamless integration of peripheral images**
- **New 20x zoom camera and remote camera control**
- **Fleet Monitoring**

Use Cases

ED Triage

Divert select ED cases to onsite virtual visits on the C250 telemedicine cart and address increasing patient volumes and patient wait times in the emergency department to improve efficiency. With just one touch to start a virtual visit, the C250 simplifies ED staff connections to remote providers who can utilize tools like enhanced camera control and integrated peripherals to assess patients and enable a quicker discharge of the patient.

Telestroke

Utilizing the C250 cart for telestroke care allows providers to more quickly diagnose and treat stroke patients. New cases can be created with one click to document vital information in the stroke intake form. The cart's agility and small footprint make it a great solution for busy emergency departments, allowing on-site staff the ability to move it quickly to where it is needed most. Enhanced camera control and 20x zoom enable the remote neurologist to examine the patient carefully and recommend the best treatment.

Acute Behavioral Health

Increasing numbers of mental health patients presenting in the ED are driving demand for more efficient and flexible treatment solutions. The C250 telemedicine cart permits staff to bring in a psychiatrist with one touch. The agile cart can be easily moved in and out of treatment rooms to ensure patient safety. Leveraging American Well's provider network through the C250, health systems can address psychiatrist shortages, ensure better treatment for patients in mental distress, and reduce lengths of stay.

School Health

Being able to access care in a school environment provides students and parents a convenient means of seeking care without missing school or work. The C250 telemedicine cart allows onsite staff to connect to a board-certified provider in American Well's provider network or to your own providers. The cart's user-friendly interface makes it easy to use, and the seamless integration of peripheral devices helps with diagnosis of illnesses and the treatment of chronic diseases.

TELEMEDICINE CART

American Well C250

SAFETY

- Registered with the US FDA as a Class I Medical Device
- Compliant with FDA 21 CFR 820 Quality System Requirements
- Certified to the IEC 60601-1 Electrical Safety Standard
- Manufactured in ISO 13485:2016 certified production facility
- Certified to the FCC 47 CFR Part 15:Radiate Emissions

DIMENSIONS

- 72" (182.88cm) max. height (adjustable)
- 19" (48.26cm) wide
- 21" (53.34cm) depth

CAMERA

- Integrated or PTZ (optional)
- 10x or 20x zoom with PTZ option

DISPLAY

- 13.3" Display
- Control option: Touchscreen (optional USB keyboard)

INPUTS/OUTPUTS

- 4 - USB 2.0
- 1 - USB 3.0
- 1 - integrated microphone 3.5 mm

NETWORK

- Wired Ethernet
- Integrated wireless (2.4 GHz and 5 GHz, 802.11 a/b/g/n/ac), WPA and WPA2, 802.1X (PEAP)

POWER

- Lithium Iron battery provides 3 hrs

STORAGE

- Lockable Drawer (7.5" x 11.5" x 2.25")

American Well®

WHAT WE DO

American Well is a leading telehealth platform in the United States and globally, connecting and enabling providers, insurers, patients, and innovators to deliver greater access to more affordable, higher quality care.

American Well believes that digital care delivery will transform healthcare. The Company offers a single, comprehensive platform to support all telehealth needs from urgent to acute and post-acute care, as well as chronic care management and healthy living. With over a decade of experience, American Well powers telehealth solutions for over 130 health systems comprised of 2,000 hospitals and 55 health plan partners with over 7,000 employers – covering over 150 million lives.

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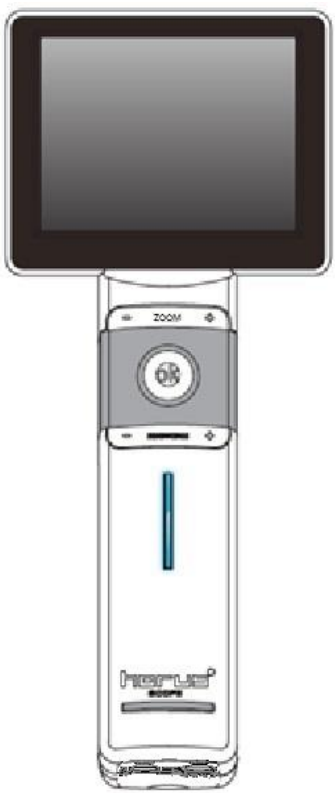
Exhibit M



Horus Scope

Series 3

User Manual

PMNL 160 Rev 0 9/19

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Before use

Prior to installation and start-up of the Horus Scope, carefully read the user manual. As with all technical devices, the proper function and safety operation of this device depend on the user complying with the safety recommendations presented in these operating instructions. In addition, please make sure it does not appear damaged or broken. If there are breaks on the outer casing or other visual defects, please contact the manufacturer or a certified service facility.

⚠ This device to be sold and distributed, and it should be used only by or on the order of a physician in hospital or Clinic.

⚠ This instrument must not be used for the following patients:
- Patients who are hypersensitive to light.
- Patients who recently underwent photodynamic therapy (PDT).
- Patients taking medication that causes photosensitivity.
- Patients with a history of migraines.
- Patients with a history of photosensitive epilepsy.
- Patients with any kind of disease which could be induced by flash or strong light.

Camera handling

Protect the camera from excessive vibration, force, or pressure.

⚠ Avoid using the camera under the following conditions, which may damage the lens, the monitor, or the control unit and may also cause the camera to malfunction or prevent recording:
- Dropping or hitting the camera against a hard surface.
- Exerting excessive force on the lens or the monitor.

The camera is not dust resistant, splash resistant, or waterproof. Avoid using the camera in places with excessive dust or sand, or where water can come into contact with the camera.

⚠ Avoid using the camera under the following conditions, which present the risk that sand, water, or foreign material entering the camera through the lens or gaps around buttons. Be especially careful because these condition may dam- age the camera, and such damage may not be repairable:
- Operate in extremely dusty or sandy places
- Exposing the camera to rain or moisture

Condensation (when the lens or the monitor is fogged up)

⚠ Condensation may occur when the camera is exposed to sudden changes of temperature or humidity. Avoid these conditions because they may soil the lens or the monitor, cause mold, or damage the camera.

⚠ If condensation does occur, turn off the camera and wait for about two hours before using it. Once the camera adjusts to the surrounding temperature, the fogging will clear naturally.

Safe eye screening

⚠ While no acute optical radiation hazards have been identified with the camera, it is recommended that the intensity of light directed into the patient's eye be limited to the minimum level necessary for diagnosis. Infants, aphakes, and persons with diseased eyes are

at greater risk. The risk may also be increased if the person being examined has had any exposure to the same instrument or any other ophthalmic instrument that uses a visible light source within the previous 24 hours. This will apply particularly if the eye has been exposed to retinal photography. The intended use of this device is for routine ophthalmic exams of typically less than 60 seconds per eye. While any medical procedure has its benefit versus risk factor, more complicated exams should not exceed three minutes of exam time within 24 hours. Significant use of this device beyond its intended use is not recommended as it may cause harm to the eyes.

⚠ During the operation of using the camera, please follow the below instructions.

- Always use the camera or accessories in accordance with the directions and recommendations contained in this user manual.
- When operating the device, please make sure that the optical lens does not touch the eyes or nose of the patient in order to avoid harm.
- For illumination and photography with the camera, do not select an exposure higher than required. Do not shine light on the eye beyond the recommended time during examination. Otherwise, the examined eye may experience pain or be injured.

No compensation for missed shots

⚠ We cannot compensate for missed shots if technical problems with the camera or card prevent recording.

Usage cautions and notes

When in use

⚠ The camera may become warm if used for long periods of time, but this is not its fault.

⚠ Keep the camera as far away as possible from electromagnetic equipment (such as micro-wave ovens, TVs, video games, etc.).

⚠ Do not use the camera near radio transmitters or high-voltage lines.

⚠ Never leave the camera and the battery in a car or on a car hood in the summer. Doing so may cause leakage of the battery electrolyte, overheating, fire, or a battery explosion due to the high temperature.

⚠ If the fundus lens and control unit get wet, do not attempt to dry with a heater, microwave, autoclave, or UV light.

⚠ Do not extend the supplied cables. Do not keep the power cord near any heat source.

⚠ When the camera is not in use, please disconnect the power plug and keep it in a safe place.

⚠ In any operating conditions, the camera can be returned to the photo mode is regarded as the normal state.

⚠ The eye cannot be exposed to the illumination light of DOC 100S/300S, DDC 100/200 and DGC 100 at operation.

Charging the battery

⚠ The time required for charging varies depending on the conditions of battery usage. Charging takes longer at high or low temperatures and when the battery has not been used for some time.

⚠ The battery will get warm during charging and for some time thereafter.

⚠ The battery will be drained completely if not used for long periods of me, even after being charged.

⚠ Only use Li-ion Battery 3.6V / Capacity 3350mAh which shall be provided by the manufacturer or distributors. The battery has designed the protection circuit. To ensure the

safety of the product operation, if the battery reaches its life time, please contact the manufacturer or distributor to buy the spare battery.

NOTE

The battery cannot be affected by external force impact. Its appearance cannot be damaged. If the battery is broken or damaged by external force, DO NOT USE to avoid dangerous.

Memory cards

⚠ If you purchase different memory capacity of memory card, must be preceded format to FAT32.

⚠ To prevent damage to cards and data:

- Avoid high temperatures, direct sunlight, electromagnetic fields, and static electricity.
- Do not bend, drop, or expose to strong impacts.
- Do not touch the terminals or allow them to become dirty or wet.
- When operating this device, please do not remove or insert the memory card.

When disposing of/transferring memory cards:

⚠ If using the "format" or "delete" functions on your camera or computer, this only changes the file management information and does not completely delete the data from the memory card. When disposing of or transferring your memory cards, we recommend physically destroying them or using commercially available computer data erasing so ware to completely delete the data from the card. Data on memory cards should be managed responsibly.

Accessories

About the slit lamp jig:

⚠ Attach the slit lamp jig only to slit lamp equipment that has been qualified by JEDMED. Make sure the jig is completely locked by pushing it downward.

⚠ The slit lamp jig is only suitable for 39-7428.

Protection

⚠ Do not attempt to remove the cover from the product to prevent the product from malfunctioning.

⚠ No modification of this device is allowed. The performance would be subject to any modification and may cause hazardous radiation exposure.

EMC (electromagnetic compatibility)

During installation and opera on of the device, observe the following instructions:

⚠ Do not use the device simultaneously with other electronic equipment to avoid electromagnetic interference with the operation of the device.

⚠ Do not use or stack the device near, on, or under other electronic equipment to avoid electromagnetic interference with the opera on of the device.

⚠ Do not use the device in the same room as other electronic equipment, such as life-support equipment that has major effects on the life of the patient and results of treatment, or any other measurement or treatment equipment that involves small electric current.

⚠ Do not use the system with portable and mobile radio frequency communication systems because that may have an adverse effect on the operation of the device.

⚠ Do not use cables or accessories that are not specified for the device because that may increase the emission of electromagnetic waves from the device and decrease the immunity

of the device to electromagnetic disturbance.

⚠ Do not touch the lens connecting pins of the control unit or the signal pad of the lenses without special precautions.

Cleaning and Disinfection

The device is a precision photo electronic instrument that shall be handled with specific care. Please note the following cleaning instructions:

⚠ Turn off the device before cleaning it.

⚠ Disinfect the control unit and charging station with CaviWipes and maintain 3~5 mins. Wait for the cleaning liquid to dissolve before turning the power on and connecting the charging station and USB cable to the control unit.

⚠ It is recommended to clean the fundus lens with a CaviWipes that is commercial product and be manufactured by THORLABS Inc. (www.thorlabs.com).

⚠ If a replacement for the eyecup or contact plate is needed, please contact the manufacturer or retailer. Clean the eyecup or contact plate before each use:

⚠ Disinfect the eyecup or contact plate with CaviWipes

NOTE

The device is not intended to be sterilized. Disinfect the control unit and charging station with CaviWipes).

Maintenance

⚠ Please check control unit and optical lens once every 3 months.

It is the health care provider to protect patient health information and to meet regulatory and HIPAA compliance. The images on 39-7420-3P may contain identifiable patient information and it is the responsibility of the health care provider to ensure that data safeguards are implemented to protect patient health information.

Please note that the actual controls and components, menu items, and other information of your camera may differ from those in the illustrations provided in these instructions.

Operating Environment

- Ambient temperature: 10°C to +35°C
- Relative humidity: 30% to 90%
- Atmospheric pressure: 800hPa to 1013hPa
- Shock (without packing): 10G, duration 6ms

Environment for Storage

- Ambient temperature: -10°C to +55°C
- Relative humidity range: 10% to 95%
- Atmospheric pressure: 700hPa to 1013hPa

Environment for Transportation

- Ambient temperature: -40°C to +70°C
- Relative humidity range: 10% to 95%
- Atmospheric pressure: 500hPa to 1013hPa
- Vibration, sinusoidal: 10Hz to 500 Hz: 0.5G
- Shock: 30G, duration 6ms
- Bump: 10G, duration 6ms

NOTE

It is recommended to remove the battery if the device is stored over two weeks.

Regulations

- U.S. Federal law restricts this device to be sold and distributed, and it should be used only by or on the order of a physician in hospital.
- This device has been tested and found to comply with the limits for medical devices to the IEC 60601-1-2: 2014. These limits are designed to provide reasonable protection against harmful interference in a standard medical installation. If this device does cause harmful interference to other devices, which can be determined by turning the system off and on, the user is encouraged to try to correct the interference through one or more of the following measures: Reorient or relocate the receiving device.
  - Increase the separation between the system and other devices.
  - Connect the device to an outlet on a circuit different from that to which the other device(s) are connected.
  - Consult the manufacturer or field service technician for help.
- The International Electro Technical Commission sets the essential requirements for electrical and electronic equipment that may disturb or be disturbed by other equipment. The device complies with these requirements as shown in the tables in “Symbols and standards: EMC”. Follow the guidance in the tables for use of the device in an electromagnetic environment.

Names of components

Scope of Delivery

Product Name	Model Name	Accessories
Control unit	39-7420-3P	1. Battery 2. Power adapter 3. Mini USB cable 1.8m (Shield) 4. Micro HDMI cable 2.0m (Shield) 5. Charging station 6. Memory card 7. Portable chin rest (Optional) 8. Image Management System, Model: SA 1 standalone (option) 9. Image Management System, Model: SB 1 (free download)
Digital Otoscope	39-7422-3P 39-7422-1	1. Specula (Disposable/Optional)
Digital eye fundus camera Digital Ophthalmoscope	39-7428	1. Eyecup 2. Horus Portable Chin Rest 3. Slit-Lamp Jig (Optional)
Digital Anterior Scope	39-7431 39-7433-3P	1. Forehead(Optional)
Digital Dermatoscope	39-7424-2P 39-7424	1. Contact plate (Optional)
Digital Speculum	39-7426	
Horus Scope Adapter	Horus Scope Adapter	1. Coupler (Optional)

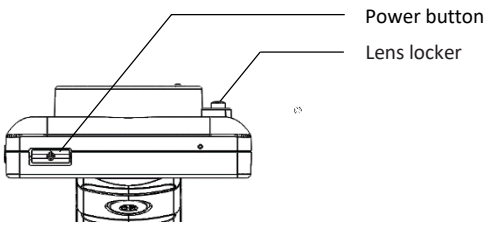
Intended for use

It is the health care provider to protect patient health information and to meet regulatory and HIPAA compliance. The images on 39-7420-3P may contain identifiable patient information and it is the responsibility of the health care provider to ensure that data safeguards are implemented to protect patient health information.

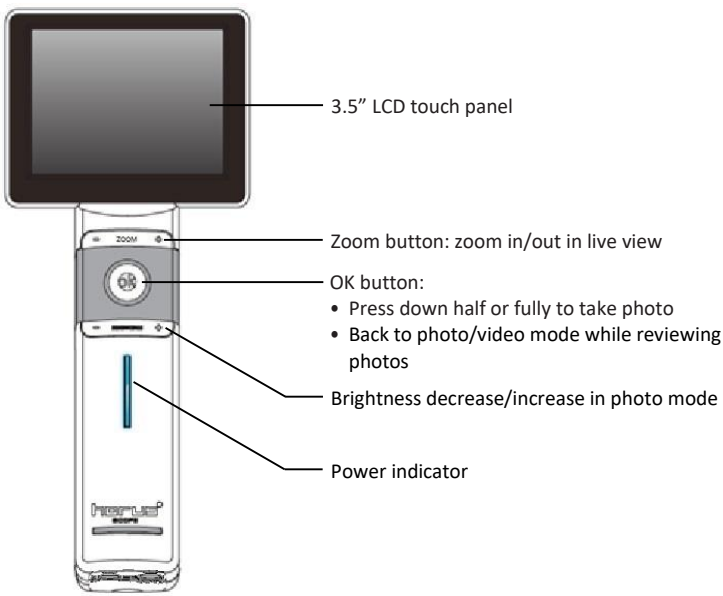
Product name	Model Name
Control unit	**39-7420-3P**
An interchangeable lens digital camera used to record digital photographs and video of human eye, human ears, human skin and human body.	
Digital Otoscope	**39-7422-3P** **39-7422-1**
A digital hand-held otoscope used to record digital photographs and video of the human ear's canal and tympanic membrane.	
Digital Eye Fundus Camera	**39-7428**
A digital hand-held eye fundus camera used to record digital photographs and video of fundus (including retina, macula and optic disc) of the human eye and surrounding area.	
Digital Anterior Scope	**39-7431** **39-7433-3P**
A digital hand-held anterior scope used to record digital photographs and video of anterior area of the human eye and surrounding area.	
Digital Dermatoscope	**39-7424-2P** **39-7424**
A digital hand-held Dermatoscope used to record digital photographs and video of the human skin.	
Digital Speculum	**39-7426**
A digital hand-held camera used to record digital photographs and video of the human body and oral cavity.	
Horus Scope Adapter	**39-7420-3P**
An adapter designed to connect the control unit of MiiS Horus Scope DSC 300P and the existing endoscope in the market. The assembly system (control unit & MiiS Adapter & existing endoscope in the market) can be used to record digital photographs and video of the human body.	

Control Unit

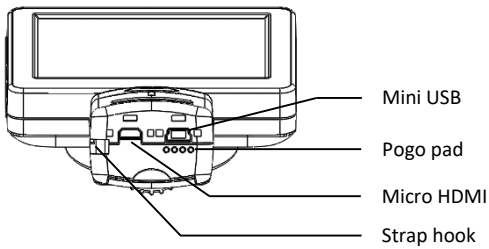
Top view ››



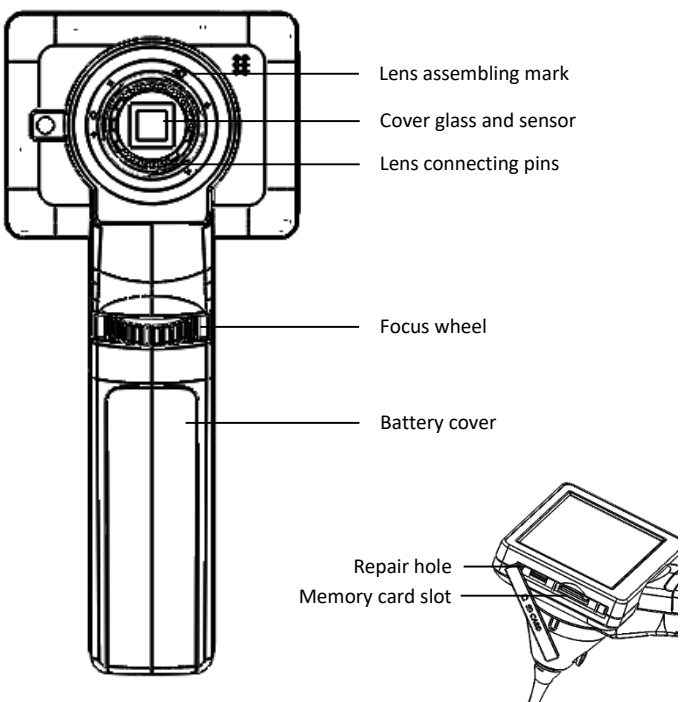
Front view ››



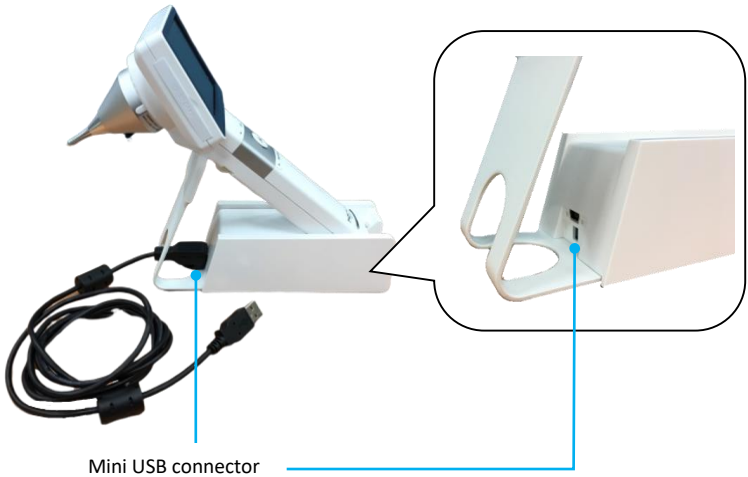
Bottom view ››



Rear view ››



Charging Station

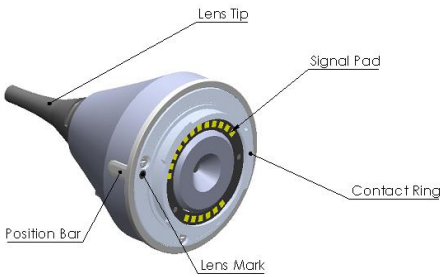


Introduction of scopes

Digital Otoscope

39-7422-3P

Structure

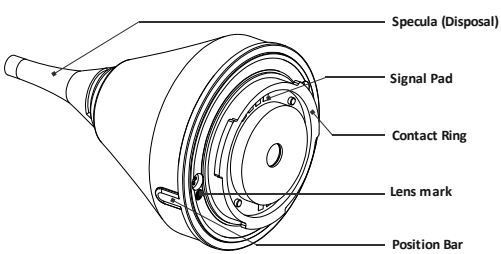


Technical Description

Focus Range	7~20 mm (Typical)
Dimension	4.3 X 4.3 X 7 cm (Typical)
Weight	69 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)

39-7422-1

Structure



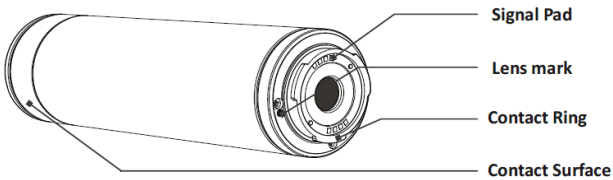
Technical Description

Focus Range	5~50 mm (Typical)
Dimension	4.3 X 4.3 X 7 cm (Typical)
Weight	69 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)

Digital Eye Fundus Camera

39-7428

Structure

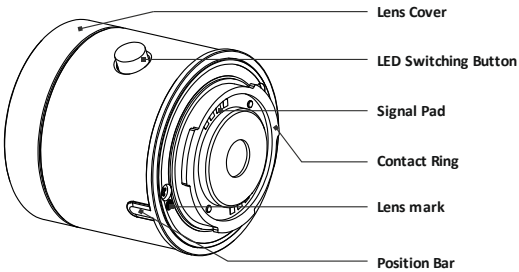


Technical Description

View Angle	40 Degree (Typical)
Diopter	-20 ~ +20D (Typical)
Dimension	4.3 X 4.3 X 12.9cm (Typical)
Weight	141 Grams (Typical)
Search Fundus Lighting	Two modes, natural white Light Emitting Diode (LED) or infrared LED
Camera / video flash light	Natural White Light Emitting Diode (LED)

MiiS Horus Scope DEA 100 (Digital Anterior Scope)

Structure



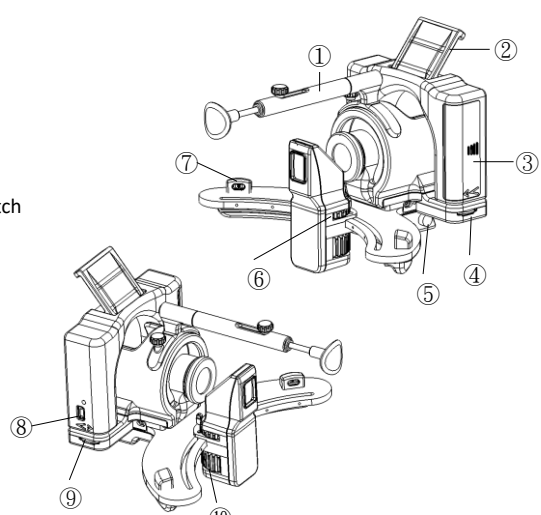
Technical Description

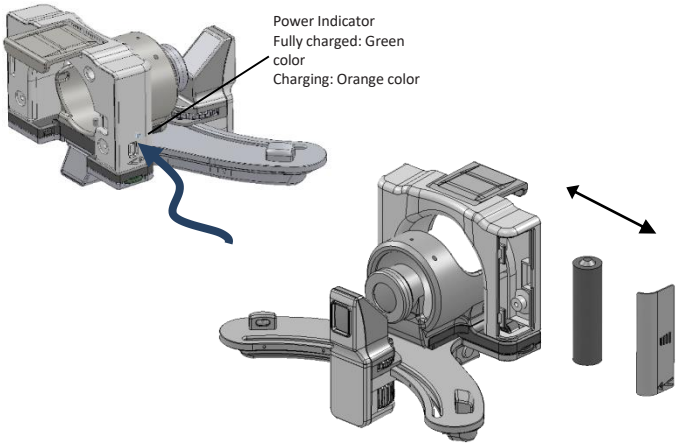
View Angle	11 mm (V)*19.6 mm (H)*22.47 mm (Diagonal) @ Working Distance 30 mm (Typical)
Dimension	4.3 X 4.3 X 4.5 cm (Typical)
Weight	91 Grams (Typical)
Camera / video light source	Natural White/Blue Light Emitting Diode (LED)
LED Switching Button	Switch to blue LED by the LED Switching Button to take fluorescence image of cornea.

Illumination Light Source for Eye anterior illumination system

Structure

① Forehead stopper
② Locking structure
③ Battery groove
④ Slit light control knob
⑤ Auxiliary light position switch
⑥ Filter wheel
⑦ Auxiliary lighting
⑧ Charge port
⑨ Auxiliary light control knob
⑩ Silt wheel





NOTE

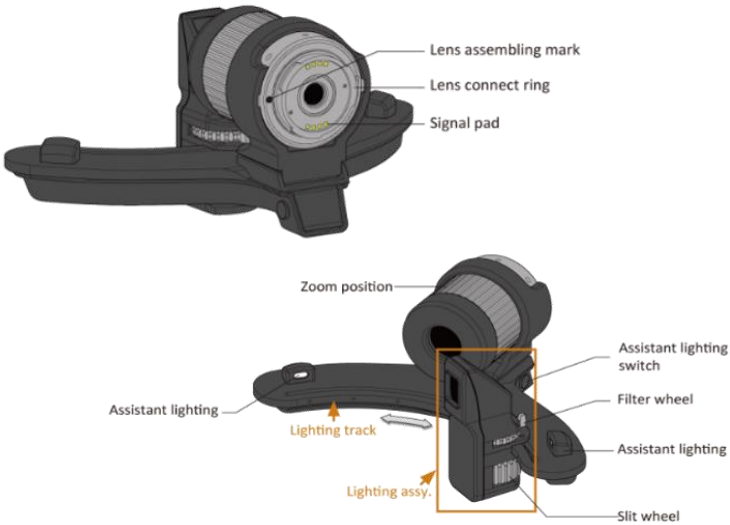
If you connect the USB cable illuminator with a computer, please connect two USBs. If you use the power adapter to charge, just use one USB.

Technical Description

View Area	25.02 mm (typ. ±5%)
Working distance	80mm
Illumination Angle (degrees)	± 45 degree (± 5%)
Slit Length(mm)	10 mm (± 10%)
Min Slit Width (mm)	<0.2 mm
Max Slit Width (mm)	Equal to slit length. (10mm)
Slit Width Selection	<0.2, 0.2, 0.5, 2, 5, ϕ10 mm
Filter	Transparent, Cobalt Blue, Red-free (Green)
Light	Conform to Group II of ISO 15004-2:2007(E)
Weight	345g (typ. , include Forehead stopper)
Dimension	178mm x 160mm x 107mm
Power source	Rechargeable Li-ion Battery 3.7V/800mAh (2.96Wh)
Operation time	90 minutes for continuously use

Digital Anterior Scope

Structure

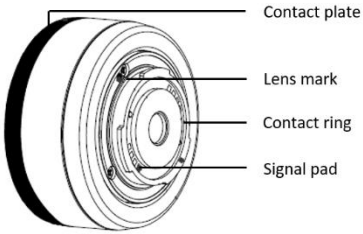


Technical Description

View Area	Wind End (H) 23.88*(V) 17.71 mm (typ. ±5%) Tele End (H) 11.88*(V) 8.91 mm (typ. ±5%)
Working distance	80mm (Typical)
Illumination Angle (degrees)	± 45 degree (± 5%)
Slit Length	10mm (typ. ±10%)
Slit Width Selection	<0.2, 0.2, 0.5, 2.0, ϕ10 mm
Filter	Transparent, Cobalt blue, Red-free (Green)
Light	Conform to group II of ISO 15004-2:2007
Weight	580 Grams (Typical)

39-74247-2P

Structure

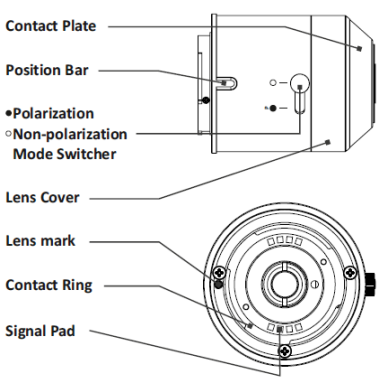


Technical Description

View Angle	20 mm diameters (Diagonal) (Typical)
Dimension	5.5 X 5.5 X 3.45 cm (Typical)
Weight	65 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)
Polarization function	Polarized light changed by the icon on screen

39-7424

Structure

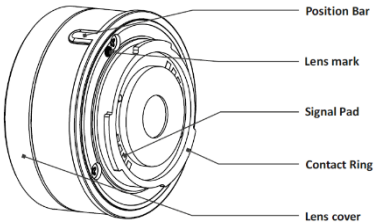


Technical Description

View Angle	10 mm diameters (Diagonal) (Typical)
Dimension	4.5 X 4.5 X 5.6 cm (Typical)
Weight	114 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)
Polarization function	Polarized light changed by the switch on lens

Digital Speculum

Structure

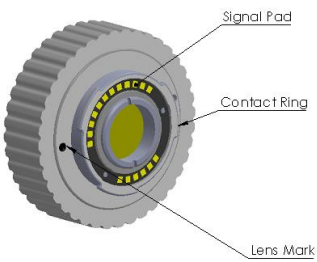


Technical Description

View Angle	88 Degree (Diagonal) (Typical)
Dimension	4.3 X 4.3 X 2.4 cm (Typical)
Weight	48 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)

Endoscope Adapter

Structure



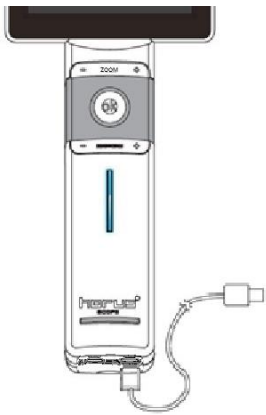
Technical Description

View Angle	88 Degree (Diagonal) (Typical)
Dimension	4.3 X 4.3 X 2.4 cm (Typical)
Weight	48 Grams (Typical)
Camera / video light source	Natural White Light Emitting Diode (LED)

Charging the battery

Always charge before first use

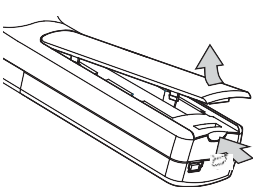
Prior to first use, insert the battery into the control unit and close the battery cover referred to the below section. Connect USB connector to the power adapter. Let the battery be charged for at least five hours.

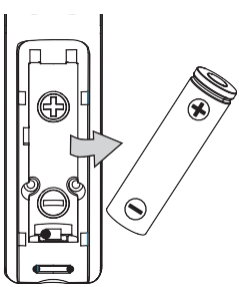


Battery replacement

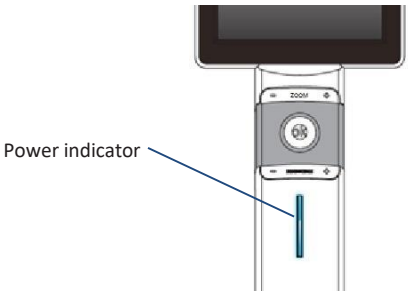
Open the battery cover by digging out the gap in the bottom of battery cover with a finger or something pointed.

- Tilt the battery cover and remove the battery cover by lifting it up.
- Remove the original battery and replace a new battery along the correct direction.
- Place the battery cover and secure it in place.





Power indicator



System Status	Power off			Power on		
Light color	No Light	Blinking blue Light	Orange Light	Blue Light	Blinking blue Light	Mixed blue and orange Light
						
Information	System off	Power less than 25%	Charging	Normal opera-tion	Power less than 25%	Connect to PC via USB cable or enable USB live video

Assembling

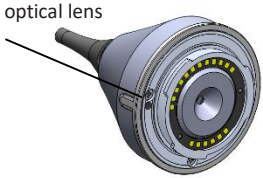
Optical lens & control unit

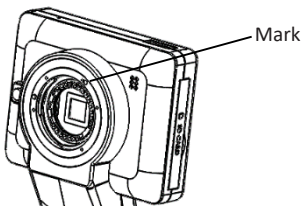
(Take digital otoscope as an example.)

Step 1. ↘

Align the marks of the optical lens and control unit.

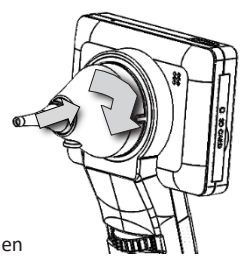
Mark on the optical lens





Step 2. →

Hold the optical lens and attach it to the control unit. Rotate and fasten the optical lens in a clockwise direction. You will hear a click when the lens locks into the control unit.

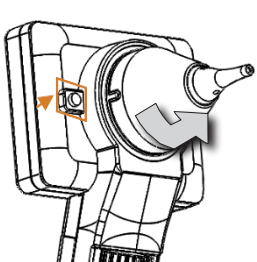


Step 3. ←

Turn on the power (→ 9). When optical lens and control unit are assembled correctly, the information icons will appear on the top of LCD touch panel. The screen will turn on, and then the blue light of the power indicator (→ 20) will also turn on.

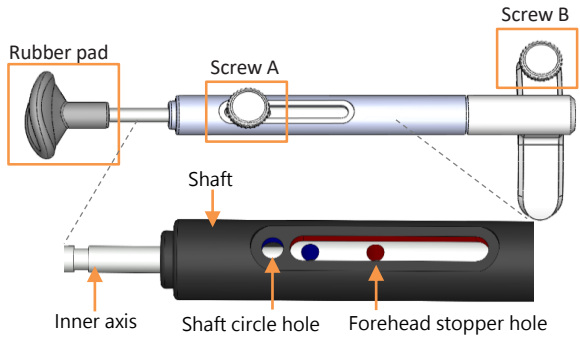
Step 4. →

To unlock the optical lens, press the lens lock and then rotate the optical lens in a counterclockwise direction. Then the optical lens will be unfastened.

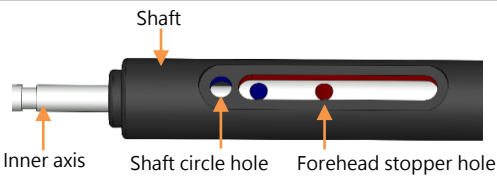


Forehead stopper assembly

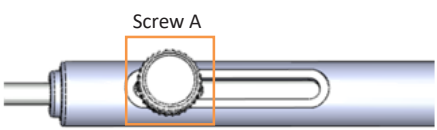
Structure of forehead Stopper



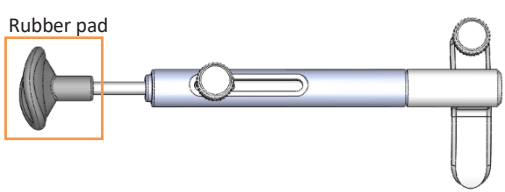
Step 1: Rolling the inner axis and the shaft to find out forehead stopper hole.



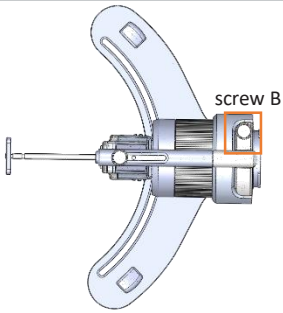
Step 2: Tighten screw A in clockwise direction to forehead stopper hole.



Step 3: Assemble rubber pad to the front end of inner axis.

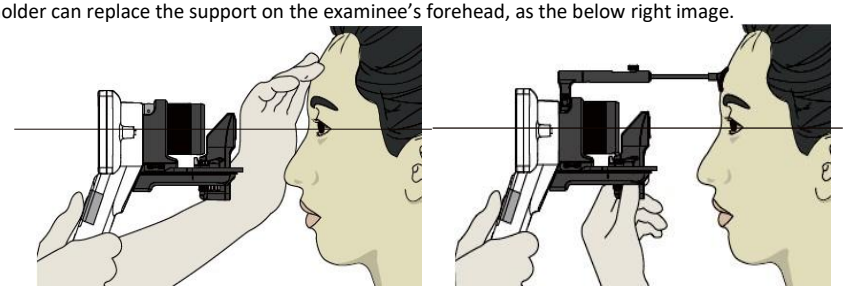


Step 4: Tighten screw B in clockwise direction to fix correction rod.



Holding position

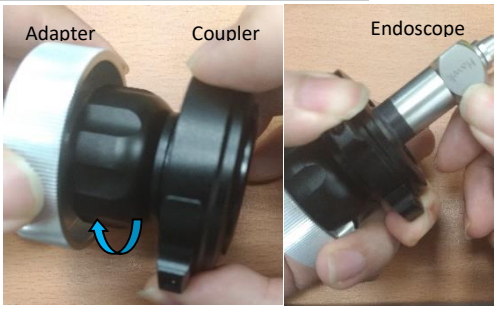
Hold the control unit with one hand and use the other hand to hold the lighting track. Maintain the lens at the same height of the eye being examined. To stabilize the lens, rest the track on the part of the hand between the thumb and index finger and put your middle and index fingers on the examinee's forehead, as showed in the left image. Besides, using the accessory of forehead holder can replace the support on the examinee's forehead, as the below right image.



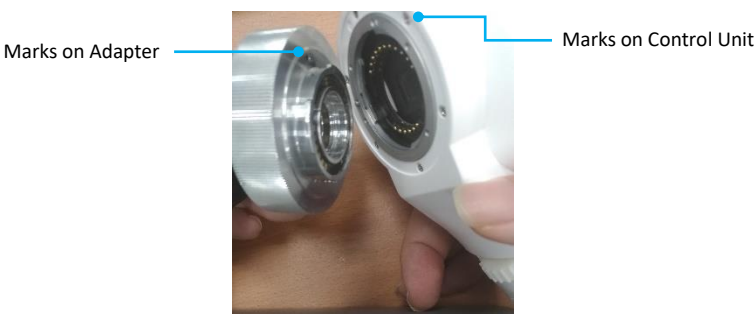
View the examined eye keeping the lens horizontal to the examined eye. Then move forward slowly until you can see the full exterior of eye in the controller screen. (For sanitary reasons, make sure the controller lens does not touch the patient's eyes or nose.)

Assembly of Horus Scope Adapter

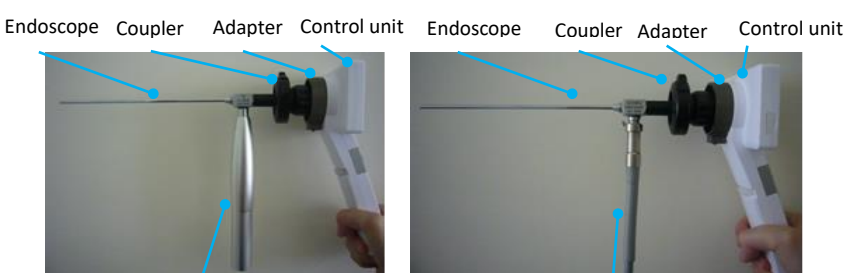
Step 1: Rotate the Coupler in clockwise direction to connect the "Horus Scope Adapter" an "Coupler", then connect the Endoscope and Coupler.



Step 2: Follow the Assemble in P.19 to fasten the Horus Scope Adapter to the Control Unit.



Step 3: Connect light source with endoscope. Horus Scope Control unit & Adapter & Existing endoscope, coupler and light source in the market.

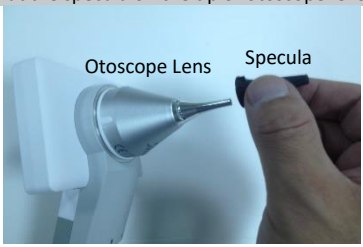


Portable Light Source

Desktop Light Source

Otoscope Specula Installation and Removal

Step 1: Put the specula on the tip of otoscope lens.



Step 2: Rotate the specula tightly to otoscope lens in clockwise direction.

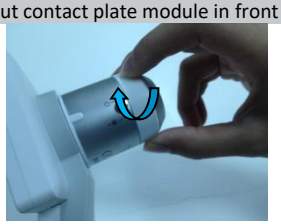
Step 3: To remove the specula, rotate in counter-clockwise direction.

Derm Contact Plate Replacement

Step 1: Hold the white portion of DDC 100 lens, and rotate to loosen the contact plate module in counter-clockwise direction.

Step 2: Separate the white plastic parts, and use new one for replacement.

Step 3: Put contact plate module in front of derm lens, rotate tightly in clockwise direction.



NOTE

Before replacement the contact plate, check the glass is clean. User can wipe clean with alcohol and dust-free paper whenever the glass is dirty or particle on it.

Derm Contact Plate Replacement

Step 1: Hold the black portion of DDC 200 lens, and rotate to loosen the contact plate module in counter-clockwise direction.

Step 2: Separate the black plastic parts, and use new one for replacement.

Step 3: Put contact plate module in front of derm lens, rotate tightly in clockwise direction.

NOTE

Before replacement the contact plate, check the glass is clean. User can wipe clean with alcohol and dust-free paper whenever the glass is dirty or particle on it.

Using the setup mode

Turn on the power

To turn on the system, press the power button (→ 10) to turn on the control unit. Approximately one to two seconds later, the boot screen will appear on the LCD panel.

Once the LCD panel shows the live image, it takes few seconds for the on-screen display (OSD) to be superimposed.

Note:
When below conditions occur, user needs to turn off the power and reassemble the optical lens and control unit.

1. Optical lens isn't correctly assembled to the control unit.

→ When turning on the device, the device stays at boot screen and can't enter to control interface.

2. The black screen appears on the LCD panel during operation.

→ Please check the optical lens is well-assembled to the control unit.

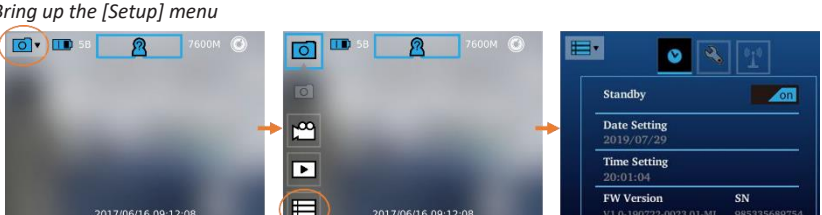
A. Digital Otoscope
Digital speculum
Digital Anterior Scope
Endoscope adapter

Enter the Setup mode

Using the [Setup] menu

It is recommended that all setting items are set according to user's requirements for first time use.

Bring up the [Setup] menu



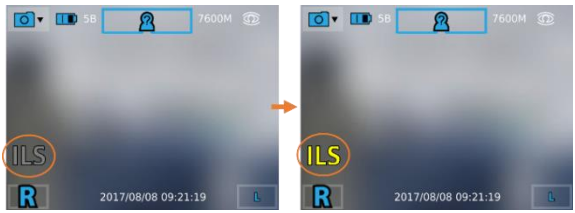
Exit the [Setup] menu

Once a setting adjustment is made, the new value affects the system immediately. Use the upper back button ‹ or the OK button to exit the screen.

Settings

[ILS mode]

User can touch ILS icon to change to ILS mode when the device is assembled with illuminator.



NOTE

ILS mode only can be used when the device is assembled with illuminator.

Auto White Balance

Using the auto white balance function to remove unrealistic color casts.

Aiming the endoscope lens at a white paper, the distance between lens and white paper is 3 to 5cm, and then press “AWB” and choose “Yes”. The screen will show “calibrating” for 3 seconds, and then the auto white balance is completed.

NOTE

Auto white balance only can be used when the device is assembled with adapter.

[Standby]

User can set standby mode to be on or off. Once the mode is on, the LCD panel will be turned off if the system is idle for three minutes. To touch the screen or press OK button to wake up the system.

[Date Setting]

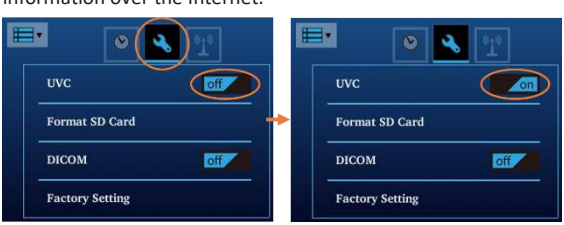
User can change the current date setting from the screen.

[Time Setting]

User can change the current time setting from the screen.

[UVC]

While connecting the device to a computer via USB cable, the product works as a USB storage device. If UVC mode is on, pictures can be shown both on the LCD panel of the product and the screen of the computer. To display image on the computer, please install webcam application prior to enabling UVC mode. A freeware webcam application (e.g., Horus UVC view, AMCap) is a software that can receive UVC signal on the computer. User can search for relevant information over the Internet.

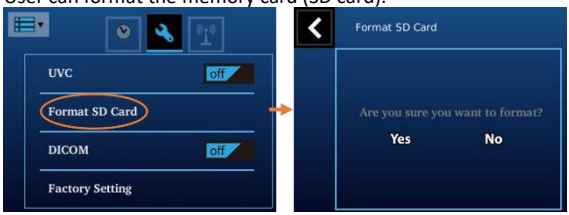


Horus UVC View

Free UVC viewer is available in any search engine.

[Format SD Card]

User can format the memory card (SD card).

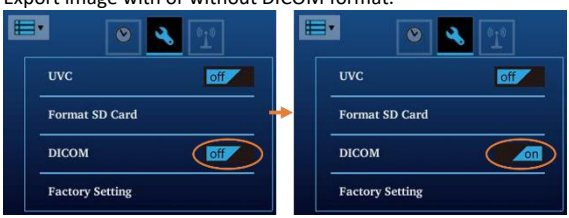


NOTE

All information will be deleted after memory card is formatted.

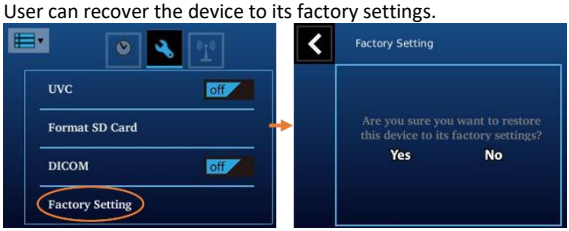
[DICOM]

Export image with or without DICOM format.



[Factory Setting]

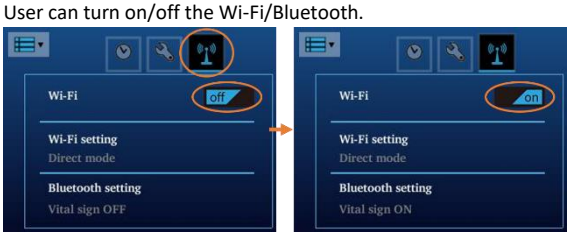
User can recover the device to its factory settings.



Wireless connection

[Wi-Fi]

User can turn on/off the Wi-Fi/Bluetooth.



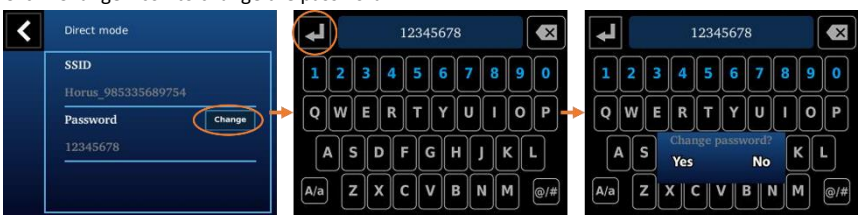
Note

Wi-Fi and Bluetooth function will be turned on at the same time.

[Wi-Fi setting – Direct Mode]

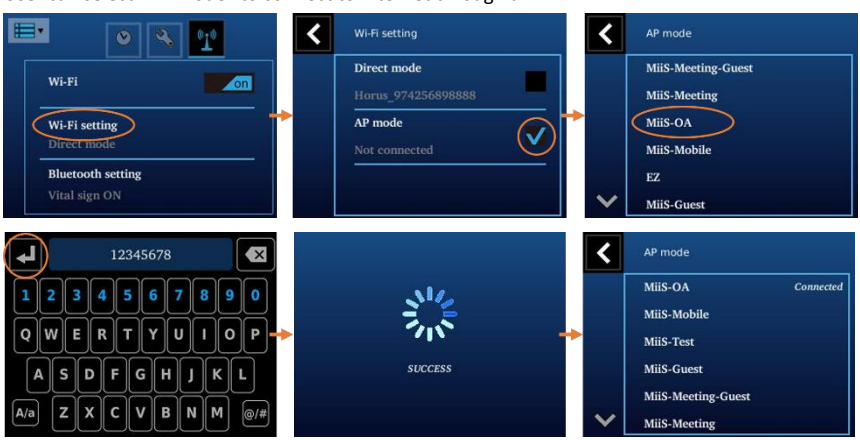
User can select “Direct mode” to connect 39-7420-3P with PC directly.

Click “Change” icon to change the password.



[Wi-Fi setting – AP Mode]

User can select “AP mode” to connect to internet through an AP.



[Bluetooth setting]

User can turn on the Bluetooth function and collect the data from specific vital sign devices.

When the Bluetooth is on, the vital sign collection icon will be shown on menu. Click it to enter the collection page.

B. Digital Eye Fundus Camera

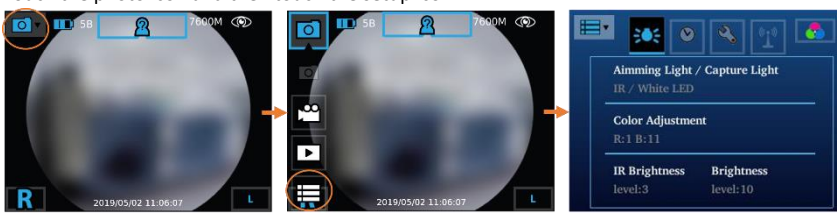
Enter the Setup mode

Using the [Setup] menu

It is recommended that all setting items are set according to user's requirements for first time use.

Bring up the [Setup] menu

Touch the photo icon and then touch the setup icon.



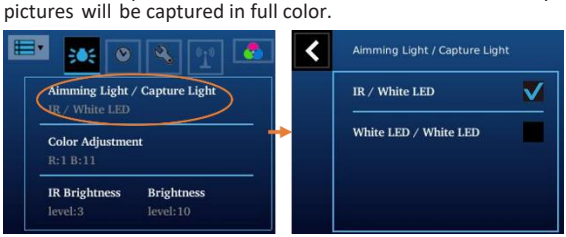
Exit the [Setup] menu

Once a setting adjustment is made, the new value affects the system immediately. Use the upper back button or the OK button to exit the screen.

Settings

[Aiming Light/Capture Light]

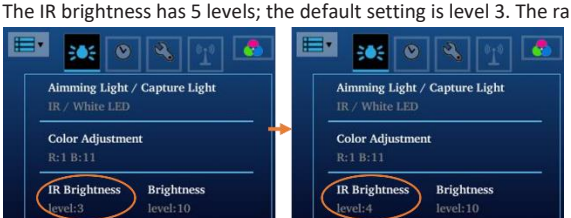
The default setting of [Aiming Light/Capture Light] is [IR/White LED]. In the setting, 39-7428 employs IR illumination for alignment and focusing to assure patient comfort. With IR, the user observes fundus images monochromatically. At the moment of pressing the shutter button, the system will turn on the white LED instantly. Static images and motion pictures will be captured in full color.



If the setting is [White LED/White LED], then the user observes images in full color and capture static images and motion pictures in full color.

[IR brightness]

The IR brightness has 5 levels; the default setting is level 3. The range is from 1 to 5.



[WHT brightness]

The WHT brightness has 16 levels; the default setting is level 10. The range is from 0 to 15.

[Standby]

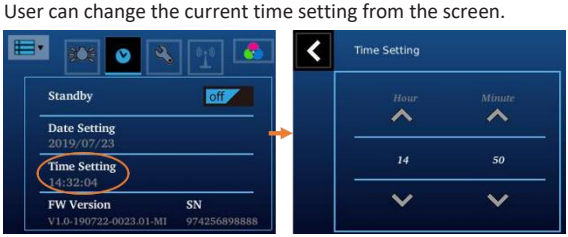
User can set standby mode to be on or off. Once the mode is on, the LCD panel will be turned off if the system is idle for three minutes. To touch the screen or press OK button to wake up the system.

[Date Setting]

User can change the current date setting from the screen.

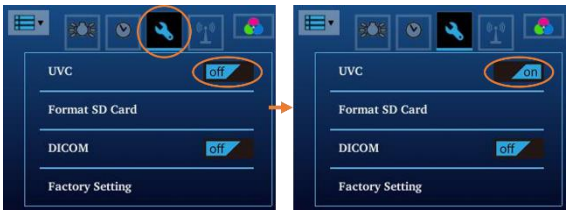
[Time Setting]

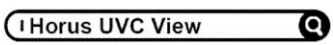
User can change the current time setting from the screen.



[UVC]

While connecting the device to a computer via USB cable, the product works as a USB storage device. If UVC mode is on, pictures can be shown both on the LCD panel of the product and the screen of the computer. To display image on the computer, please install webcam application prior to enabling UVC mode. A freeware webcam application (e.g., Horus UVC view, Amcap) is a software that can receive UVC signal on the computer. User can search for relevant information over the Internet.

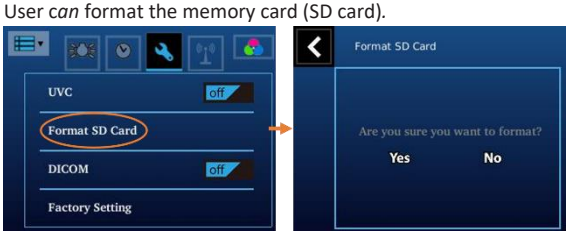




Free UVC viewer is available in any search engine.

[Format SD Card]

User *can* format the memory card (SD card).

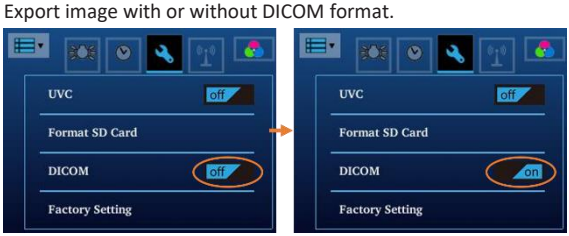


NOTE

All information will be deleted after memory card is formatted.

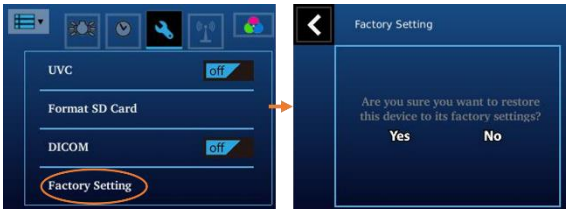
[DICOM]

Export image with or without DICOM format.



[Factory Setting]

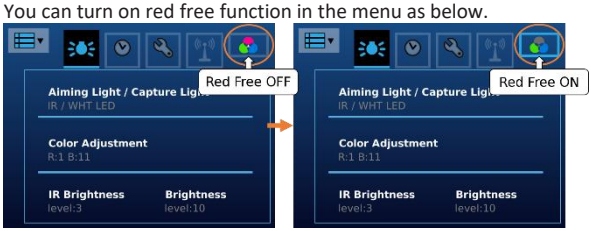
User can recover the device to its factory settings.



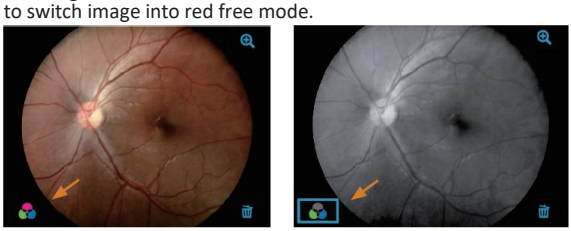
[Red Free Function]

39-7428 allows digital red free images to be created directly from the information of the initial color image.

You can turn on red free function in the menu as below.



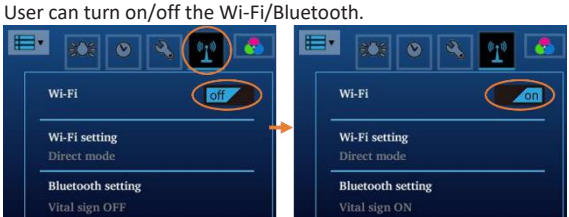
After turn on red free function, it will take more than 3 seconds to do image process after shooting. And there is a red free switch icon at the left-down corner of image. By press the icon to switch image into red free mode.



Wireless connection

[Wi-Fi]

User can turn on/off the Wi-Fi/Bluetooth.



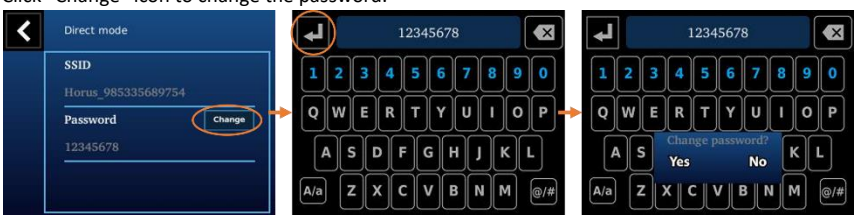
Note

Wi-Fi and Bluetooth function will be turned on at the same time.

[Wi-Fi setting – Direct Mode]

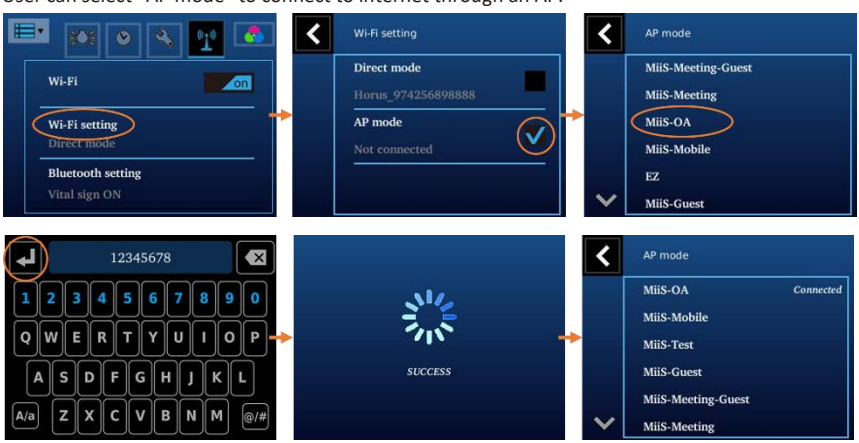
User can select “Direct mode” to connect 39-7420-3P with PC directly.

Click “Change” icon to change the password.



[Wi-Fi setting – AP Mode]

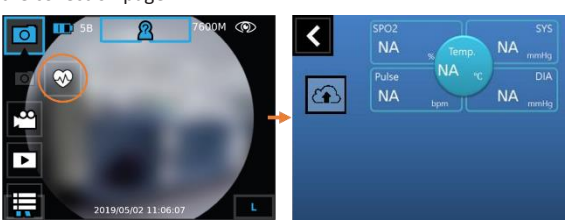
User can select “AP mode” to connect to internet through an AP.



[Bluetooth setting]

User can turn on the Bluetooth function and collect the data from specific vital sign devices.

When the Bluetooth is on, the vital sign collection icon will be shown on menu. Click it to enter the collection page.



Digital Anterior Scope

Enter the Setup model

Using the [Setup] menu

It is recommended that all setting items are set according to user's requirements for first-time use.

Bring up the [Setup] menu

Touch the photo icon and then touch the setup icon.

Exit the [Setup] menu

Once a setting adjustment is made, the new value affects the system immediately. Use the upper back button ❮ or the OK button to exit the screen.

Settings

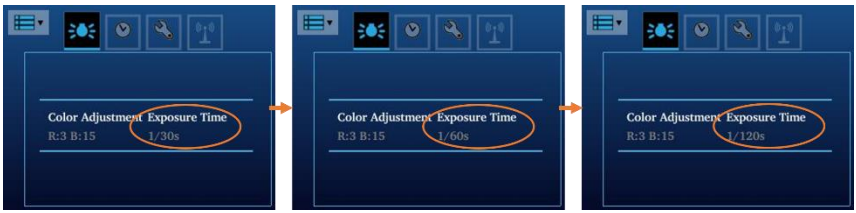
[Background Illumination]

User can turn on/off and adjust brightness of the background illumination by icon in live view mode. The brightness levels are between 0B to 5B.

[Exposure time/Color]

User can adjust Exposure time/Color setting by touching the corresponding column 1. Color adjusting range from 0 to 20. (Default: R:3, B:15)

2. Exposure time from 1/30” to 1/120”. (Default: 1/60”)

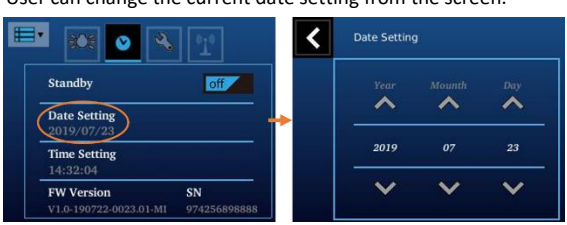


[Standby]

User can set standby mode to be on or off. Once the mode is on, the LCD panel will be turned off if the system is idle for three minutes. To touch the screen or press OK button to wake up the system.

[Date Setting]

User can change the current date setting from the screen.

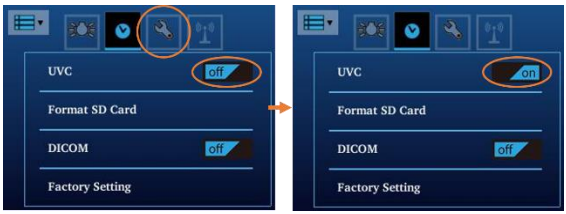


[Time Setting]

User can change the current time setting from the screen.

[UVC]

While connecting the device to a computer via USB cable, the product works as a USB storage device. If UVC mode is on, pictures can be shown both on the LCD panel of the product and the screen of the computer. To display image on the computer, please install webcam application prior to enabling UVC mode. A freeware webcam application (e.g., Horus UVC view, AMCap) is a software that can receive UVC signal on the computer. User can search for relevant information over the Internet.

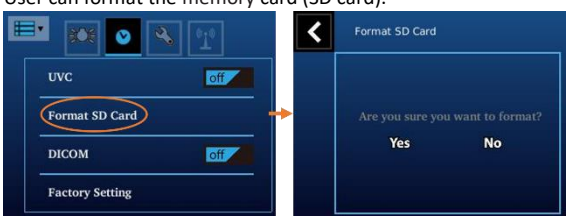


Horus UVC View

Free UVC viewer is available in any search engine.

[Format SD Card]

User can format the memory card (SD card).



NOTE

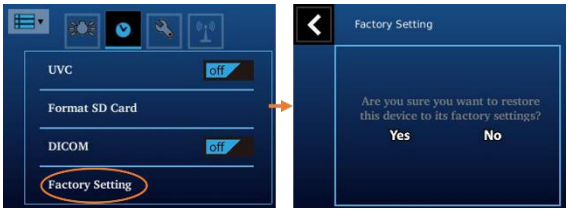
All information will be deleted after memory card is formatted.

[DICOM]

Export image with or without DICOM format.

[Factory Setting]

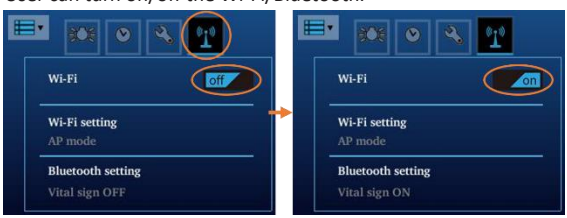
User can recover the device to its factory settings.



Wireless connection

[Wi-Fi/Bluetooth]

User can turn on/off the Wi-Fi/Bluetooth.

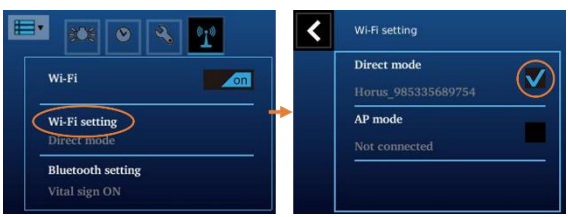


Note

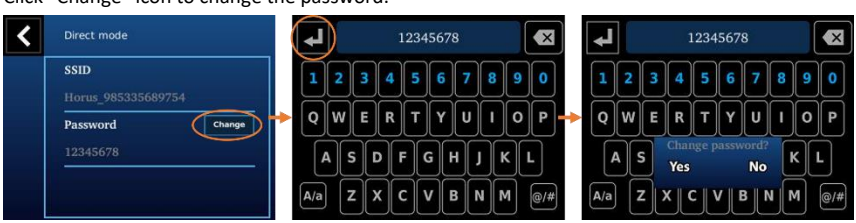
Wi-Fi and Bluetooth function will be turned on at the same time.

[Wi-Fi setting – Direct Mode]

User can select “Direct mode” to connect DSC 300P with PC directly.

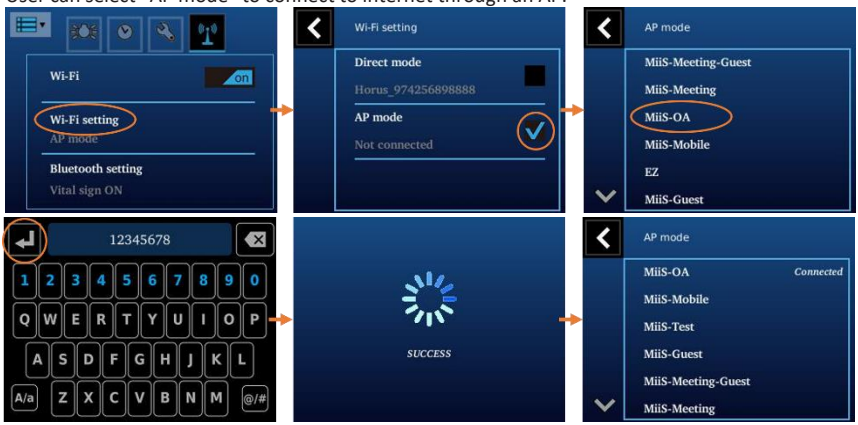


Click “Change” icon to change the password.



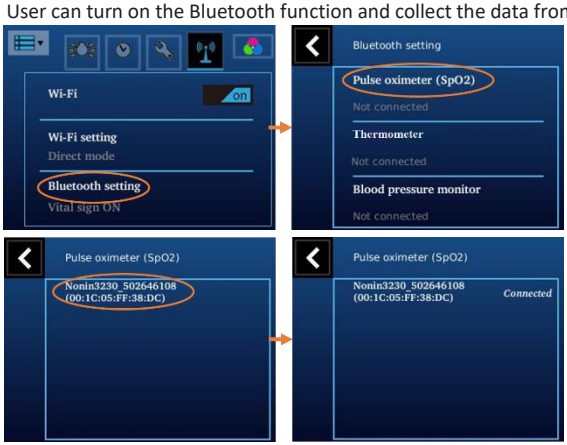
[Wi-Fi setting – AP Mode]

User can select “AP mode” to connect to internet through an AP.



[Bluetooth setting]

User can turn on the Bluetooth function and collect the data from specific vital sign devices.



When the Bluetooth is on, the vital sign collection icon will be shown on menu. Click it to enter the collection page.

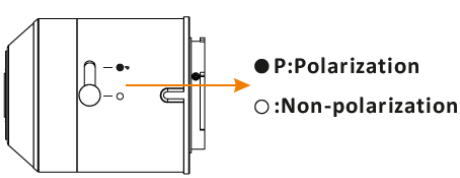
Digital Dermatoscope

Choose the type of lens

On the first-time use, User have to choose which lens is used in order to get the optimized settings in the [setup].

Polarization (39-7424)

User can use the polarization switch on lens to change the light mode.

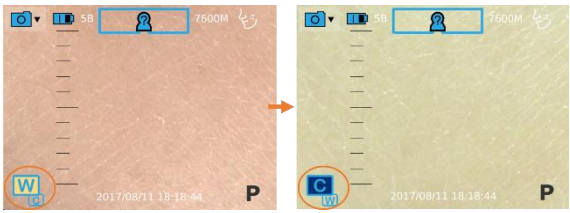


Polarization (DDC 200)

User can turn on the polarization function (P) to get polarized light, and view the dermis.

Color temperature adjustment (39-7424-2P)

In 39-7424-2P, user can click the color temperature icon (or) to get warm or cold color temperature images.



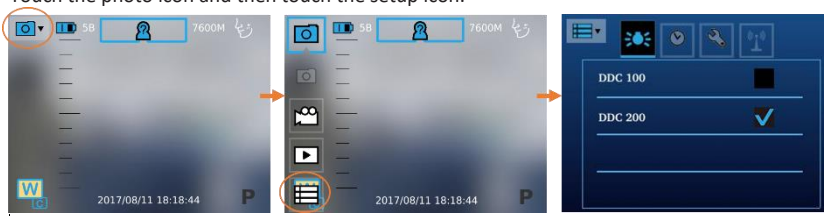
Enter the Setup model

Using the [Setup] menu

It is recommended that all setting items are set according to user's requirements for first-time use.

Bring up the [Setup] menu

Touch the photo icon and then touch the setup icon.



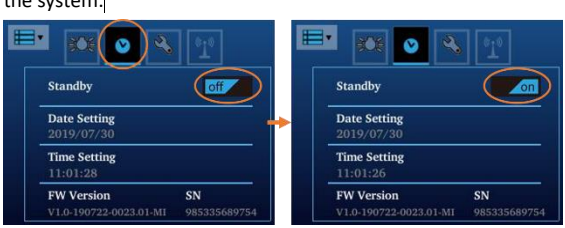
Exit the [Setup] menu

Once a setting adjustment is made, the new value affects the system immediately. Use the upper back button or the OK button to exit the screen.

Settings

[Standby]

User can set standby mode to be on or off. Once the mode is on, the LCD panel will be turned off if the system is idle for three minutes. To touch the screen or press OK button to wake up the system.



[Date Setting]

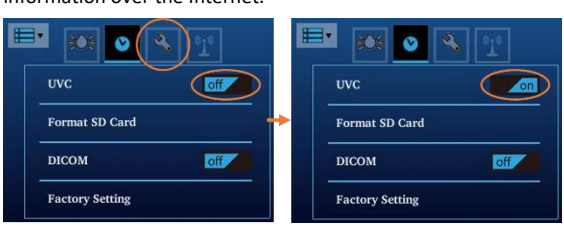
User can change the current date setting from the screen.

[Time Setting]

User can change the current time setting from the screen.

[UVC]

While connecting the device to a computer via USB cable, the product works as a USB storage device. If UVC mode is on, pictures can be shown both on the LCD panel of the product and the screen of the computer. To display image on the computer, please install webcam application prior to enabling UVC mode. A freeware webcam application (e.g., Horus UVC view, AMCap) is a software that can receive UVC signal on the computer. User can search for relevant information over the Internet.

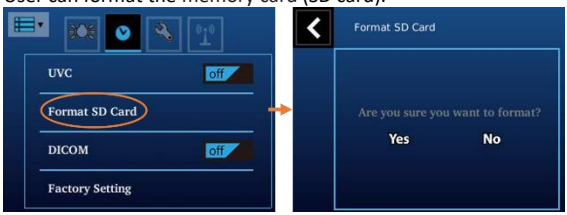


Horus UVC View

Free UVC viewer is available in any search engine.

[Format SD card]

User can format the memory card (SD card).

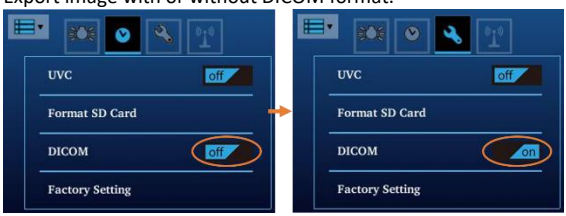


NOTE

All information will be deleted after memory card is formatted.

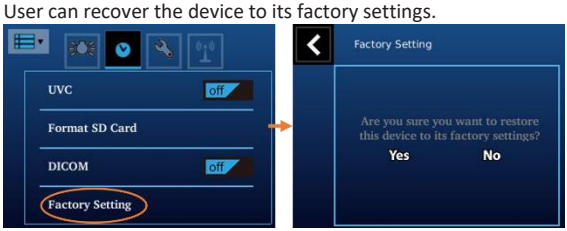
[DICOM]

Export image with or without DICOM format.



[Factory Setting]

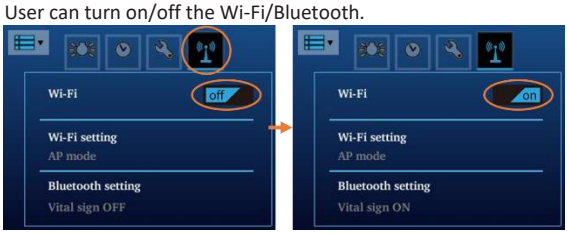
User can recover the device to its factory settings.



Wireless connection

[Wi-Fi/Bluetooth]

User can turn on/off the Wi-Fi/Bluetooth.



Note

Wi-Fi and Bluetooth function will be turned on at the same time.

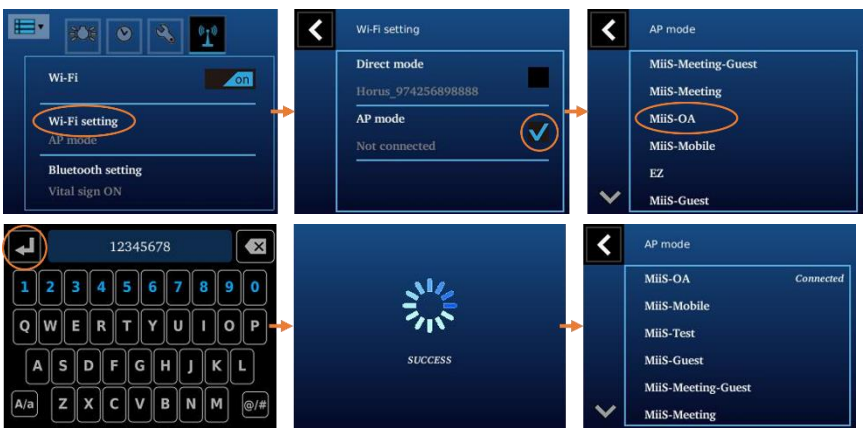
[Wi-Fi setting – Direct Mode]

User can select “Direct mode” to connect 39-7420-3P with PC directly.

Click “Change” icon to change the password.

[Wi-Fi setting – AP Mode]

User can select “AP mode” to connect to internet through an AP.



[Bluetooth setting]

User can turn on the Bluetooth function and collect the data from specific vital sign devices.

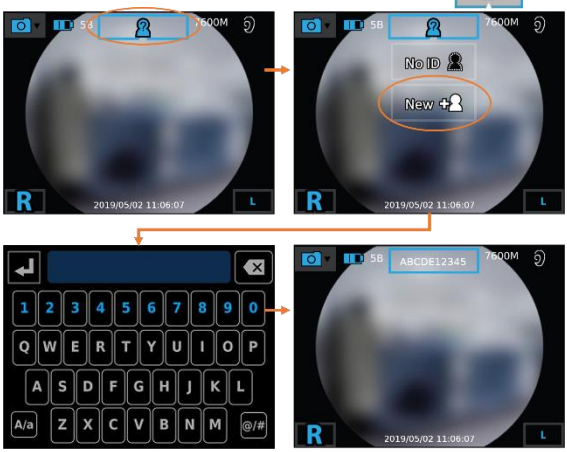
When the Bluetooth is on, the vital sign collection icon will be shown on menu. Click it to enter the collection page.

Entering the patient ID

Using patient ID as partial file name is supported in 39-7420-3P.

Create a new patient ID from scratch (DICOM off)

By gently pressing the OK button, the user always goes back to a shooting mode, either photo or video mode; from the top information icons, tap  to start the process.



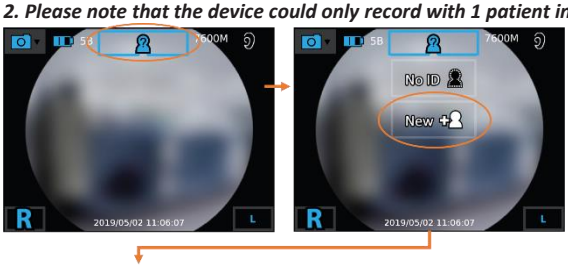
Create a new patient ID from scratch (DICOM on)

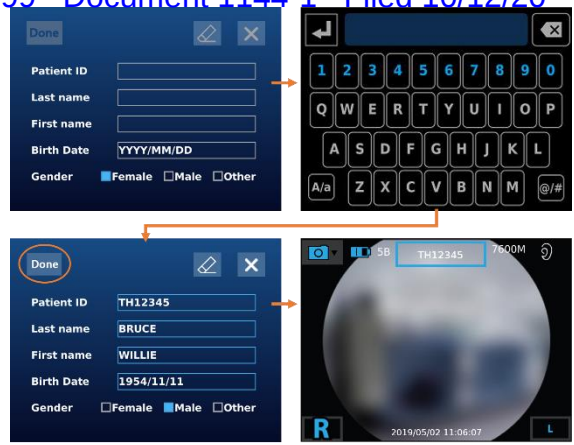
By gently pressing the OK button, the user always goes back to a shooting mode, either photo or video mode; from the top information icons, tap  to start the process.

NOTE

1. All of the information are necessary to finish this step.

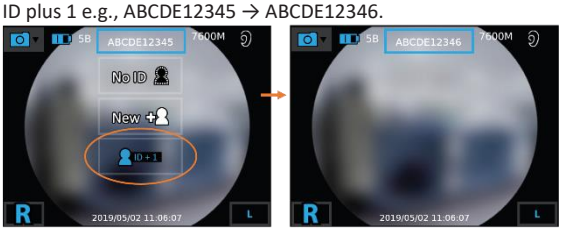
2. Please note that the device could only record with 1 patient information.





Create a new patient ID on an existing one

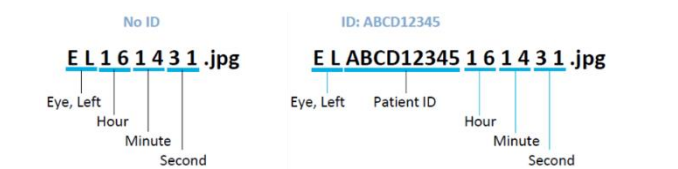
After a patient ID is set, the user can quickly create a new patient ID that is based on the existing ID plus 1 e.g., ABCDE12345 → ABCDE12346.



Meaning of each symbol:

Symbol	Refer to
OL	Left ear photo taken by the otoscope
OR	Right ear photo taken by the otoscope
EL	Left eye photo taken by the eye fundus camera
ER	Right eye photo taken by the eye fundus camera
AL	Left eye photo taken by the eye anterior camera
AR	Right eye photo taken by the eye anterior camera
DM	Epidermis photo taken
DP	Dermis photo taken
GI	Photo taken by general lens
EN	Photo taken by Adapter
HH	Hour
MM	Minute
SS	Second
XXXXX	Patient ID, up to 20 characters

Example:



The image name is explained as follows:
EL: Left eye photo taken by the eye fundus camera; hour: 16, minute: 14, and second: 31.
If the given patient number is ABCD12345, the image mane would be written as ELABCD12345161431.jpg

Sequence of operations

Step 1: Turn on the power

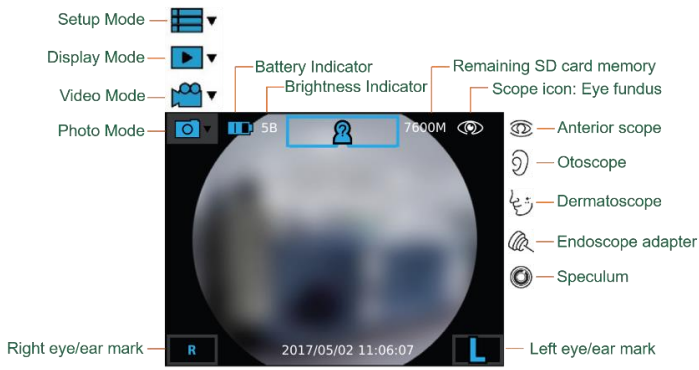
Press the power button to turn on the control unit. Approximately one to two seconds later, the boot screen will appear on the LCD panel. After about 15 seconds, the information icons will appear on the top of the LCD panel.

Step 2: Make sure memory card is inserted

Once the memory card has been inserted, the user can start to take photographs in any shooting mode, either photo or video mode.

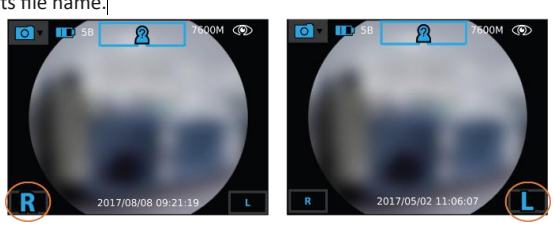
Step 3: Choose a shooting mode

Tap the photo or the video mode icon to enter a shooting mode.



Step 4: Mark left /right (DOC 300S, DOC 100S, DEC 100, EEC 100, DEA 100(with ILS 100), DEA 200P)

By doing so, the user can tell whether a photo/video is left ear/eye or right ear/eye of examinee record from its file name.



Step 5: Aim and preview

Position the camera correctly and adjust to appropriate settings to get a clear preview. The image brightness can only be changed in photo mode. And using the focus wheel to adjust focus manually.

Step 6: Press the OK button to shoot.

Photo mode

The device's default setting is "photo mode." User can take a picture or video in "photo mode" or "video mode," respectively.

Photo mode:

Using focus wheel to adjust focus manually, and then press down OK button to take picture. When a picture is just taken, the screen shows the result image in auto review mode. To leave auto review, gently press the OK button.

To adjust the magnification in live view, user can press the zoom adjustment button, to change the magnification from 1 to 4 times.

To adjust the brightness of the image, user can press the brightness adjustment button of the control unit. The higher value you set, the brighter image you get. Image brightness adjustment range:

Reference brightness table for 39-7428:

	Aiming light (IR)	Capturing light
Light Skin Blond	1B	3-5B
Light Skin Brunette	3B	8-10B
Dark Skin	5B	12-14B

The default setting of aiming light (IR) is 3, and Capture light is 10

NOTE

When taking pictures, please do not remove or insert the memory card and delete pictures, otherwise the system will be abnormal.

Video mode

Video mode: Completely press the OK button to start recording. Press again to end recording. For 39-7428, the default setting in video mode of “Aiming Light/Capture Light” is “White/ White LED.” During the video shooting, user can press “the brightness adjustment key +” to enhance the white LED for two seconds. It helps capture brighter motion pictures within a video.

NOTE

When recording videos, please do not remove or insert the memory card and delete pictures, otherwise the system will be abnormal.

Examination conditions of 39-7428

Examination conditions

After the optical lens is attached to the control unit and setup is complete, the user can start taking images. Approaches for taking the image of human eye fundus are as follows:

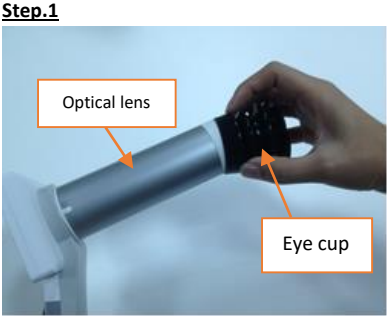
- Have the examinee stay in <5 lux dark room; in such an environment, a newspaper is nearly impossible to see. Remove the patient's glasses. Make sure that the eye's pupil has a diameter larger than 4mm, or be sure to sufficiently dilate in advance.

Eye Cup Installation

Step 1: Put the eye cup on the front of optical lens.

Step 2: If you want to change the direction of mask wing, one hand holds the lens, the other hand rotates mask to the direction you wanted. The idea is using the mask wing

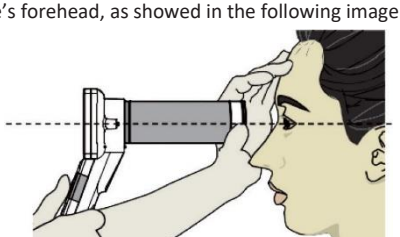
Step.1



Step.2

Holding position

Holding the control unit with one hand and use the other hand to hold the front side of the lens. Maintain the lens at the same height of the eye being examined. To stabilize the lens, rest the lens on the part of the hand between the thumb and index finger and put your middle and index fingers on the examinee's forehead, as showed in the following image.

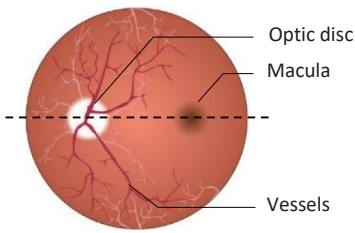


View the examined eye keeping the lens horizontal to the examined eye. Then move forward slowly until you can see the optic disk in the controller screen. (For sanitary reasons, make sure the controller lens does not touch the patient's eyes or nose.)

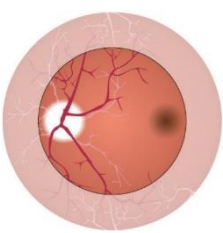
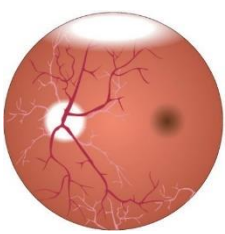
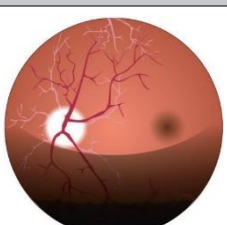
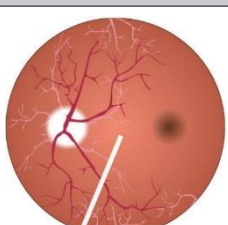
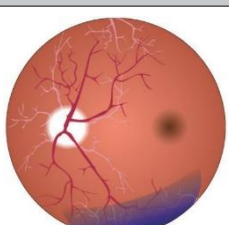
Q&A troubleshooting of 39-7428

A good image should have two characteristics:

1. Positions
   The macula and the optic disc are horizontally aligned in the middle.
2. High contrast
   The macula, optic disc, and vessels are all clear.



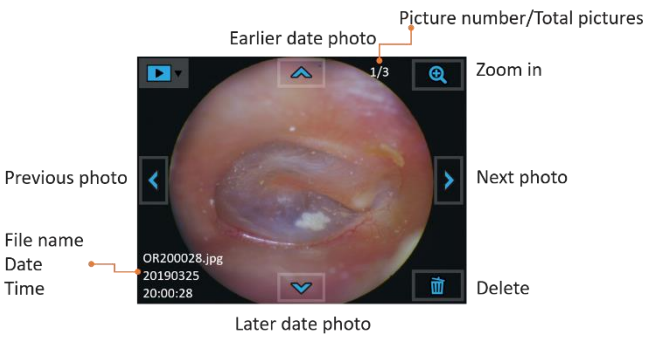
If the above characteristics can't be found in the shot, possible failures might be the following:

1. Small fundus image	2. White hot spot on the top of the image	3. Dark shadow on the top of the image
		
The lens is too far away from the examinee's eye.	The lens is too close to the examinee's eye.	The lens is much lower than the visual axis.
4. Dark shadow on the bottom of the image	**5. Line or spot within the view**	**6. Blue or white shadow on the bottom of image**
		
The lens is much higher than the visual axis.	Eyelashes are in the light path.	Cornea reflection

Display mode

Touch the photo icon and then the display icon to see the photos that have been taken.

Display mode:

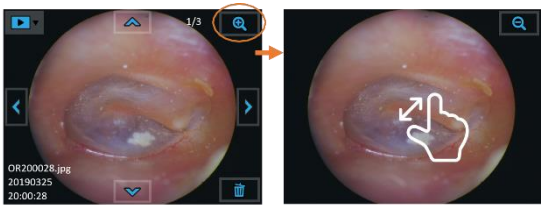


Click the left or right arrow symbol to go to the previous or next photo, respectively. Click the up or down arrow symbol to backward or forward in days. Click zoom in icon and using two fingers to zoom in and out with pinching. Tap Zoom icon again to return the original scale. Click delete icon to delete photos.

The device does not support the video file display on the control unit. Please download the video file (.avi) to the computer to watch.

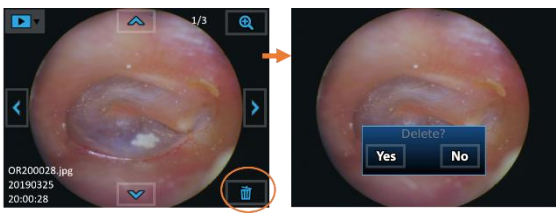
Enlarged viewing

Click zoom in icon and using two fingers to zoom in and out with pinching. Tap Zoom icon again to return the original scale.



Deleting pictures

Tap the delete icon to delete the image. By using the delete functions on your camera, this only changes the file management information and does not completely delete the data from the memory card. When disposing of or transferring your memory cards, we recommend physically destroying them or using commercially available computer data erasing software to completely delete the data from the card.



Files transferring

Transfer images to an electronic device (e.g., personal computer, laptop, or mobile phone) via the USB cable or memory card.

It is the health care provider to protect patient health information and to meet regulatory and HIPAA compliance. The images on 39-7420-3P may contain identifiable patient information and it is the responsibility of the health care provider to ensure that data safeguards are implemented to protect patient health information.

Viewing on a computer/laptop screen

Turn on UVC mode to simultaneously view images both on LCD panel and the computer/ laptop screen.

Viewing on a TV screen

Connect the camera and a TV through the Micro HDMI cable, you can simultaneously view live images on both sides.

UVC and HDMI

Photo mode:
When UVC was on and connected with the USB cable, HDMI will be turned off.

Video mode:
UVC and HDMI always be off.

Preview and playback mode:
When UVC was on and connected with the USB cable, HDMI will be turned off.

Technical description

MiiS Horus Scope DSC 300P, control unit:

Focus	Manual focus
Picture Resolution	2560 x 1920 pixels
Video Resolution	2560 x 1920 pixels
LCD Monitor	3.5” TFT LCD
Image Format	JPEG (Photograph) and H.264 (Video)
Interface	Mini USB, Micro HDMI
File Transfer	Mini USB Port to PC with USB cable 1.8m (Shield)
Dynamic Video Output	HDMI output with A-D HDMI cable 2.0m (Shield) USB live video enable from USB port with USB cable 1.8m
File Storage	Memory card, Supports 2GB to 32GB by FAT32 Format.
Dimension	(L)202.5±5% x (W)89 ±5% x (H)79 ±5% mm
Weight	275±5% grams
Power Source	Rechargeable Lithium Battery 3.6V / Capacity 3350mAh
External Power	Source: 100~240 VAC, 50/60 Hz
Power Adapter Spec.	Input Spec.: 100-240Vac, 0.6-0.3A, 50-60Hz; Output Spec.: 5V DC, 1.2A
Charging station Input Spec.	5V DC, 1.2 A
Operating Time	Standby mode: 6 hours Operating mode: 1.5~4.5 hours (Depend on optical lens used)
Charging Time	6 hours by DSC 300P
Expected service life (defined by manufacturer)	5 years from the date of initial operation *Proper maintenance is necessary.

Series 3 (Digital Otoscope)

- Focus Range：7~20mm (Typical)
- Dimension：4.3*4.3*7cm (Typical)
- Weight：69grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)

Series 1 (Digital Otoscope)

- Focus Range：5~50mm (Typical)
- Dimension：4.3*4.3*7cm (Typical)
- Weight：69grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)

Digital Eye Fundus Camera

- View Angle：40 degree (Typical)
- Diopter：-20 ~ +20D (Typical)
- Dimension：4.3*4.3*12.9cm (Typical)
- Weight：141grams (Typical)
- Search Fundus Lighting：Natural white light-emitting diode (LED) or infrared LED
- Camera / video flash light：Natural white light-emitting diode (LED)

Digital eye anterior camera

- View Area：Wind End (H) 23.88*(V) 17.71mm (typ.±5%)
  Tele End (H) 11.88*(V) 8.91mm (typ.±5%)
- Working Distance：80mm (Typical)
- Illumination Angle：±45 degree (typ.±5%)
- Slit Length：10mm (typ.±10%)
- Slit Width：0.2~10mm
- Slit Width Selection：≤0.2, 0.2, 0.5, 2.0, 5.0, Φ10mm
- Filter：Transparent, Cobalt blue, Red-free (Green)
- Light：Conform to group II of ISO 15004-2:2007
- Weight：580grams (Typical)

Digital Anterior Scope

- View Angle：11 (V)*19.6 (H)*22.47mm (Diagonal) @Working Distance 30 mm (Typical)
- Dimension：4.3*4.3*4.5cm (Typical)
- Weight：48grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)
- LED Switching Button：Switch to blue LED by the LED Switching Button to take fluorescence image of cornea.

Illumination Light Source

- View Area：25.02mm (Typical)
- Working distance：80mm
- Weight：38grams (Typical)
- Illumination Angle (degrees)：± 45 degree (Typical)
- Slit Length (mm)：10mm (Typical)
- Min Slit Width (mm)：<0.2 mm

- Max Slit Width (mm)：Equal to slit length (10mm)
- Slit Width Selection：<0.2, 0.2, 0.5, 2, 5, ϕ10mm
- Filter：Transparent, Cobalt Blue, Red-free (Green)
- Light：Conform to Group II of ISO 15004-2:2007(E)
- Weight：345g (typ., include forehead stopper)
- Dimension：178*160*107mm
- Power source：Rechargeable Li-ion Battery 3.7V/800mAh (2.96Wh)
- Operation time：90 minutes for continuously use

Series 2 (Digital Dermatoscope)
- View Angle：20mm diameters (Diagonal) (Typical)
- Dimension：5.5*5.5*3.45cm (Typical)
- Weight：65grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)
- Polarization function：Polarized light changed by the icon on touch screen

Series 1 (Digital Dermatoscope)
- View Angle：10mm diameters (Diagonal) (Typical)
- Dimension：4.5*4.5*5.6cm (Typical)
- Weight：114grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)
- Polarization function：Polarized light changed by the switch on lens

Digital Speculum
- View Angle：88 degree (Diagonal) (Typical)
- Dimension：4.3*4.3*2.4cm (Typical)
- Weight：48grams (Typical)
- Camera / video light source：Natural white light-emitting diode (LED)

Horus Scope Adapter, Endoscope adapter
- Dimension：5.0*5.0*1.8cm (Typical)
- Weight：38grams (Typical)

Liability

Manufacturer considers itself responsible for the effects on safety, reliability, and performance of the device only if

- Assembly operations, extensions, readjustments, modifications or repairs are carried out by persons authorized.
- The electrical installation of the relevant room complies with the requirements.
- The equipment is used in accordance with these instructions for use.

Disposition

⚠ Follow the local governing ordinances and recycling plans regarding disposal or recycling of device components, especially when disposing of the lithium ion battery, circuit board, plastic parts that contain brominated flame retardant, LCD, or power cord.

⚠ Follow the local governing ordinances and recycling plans when disposing of the circuit board with the lithium battery. Inappropriate disposal may contaminate the environment.

⚠ When disposing of packing materials, sort them by material and follow local ordinances and recycling regulations.

⚠ Inappropriate disposal may contaminate the environment.

⚠ When disposing of eyecup, follow the disposal procedures for medical waste such as needles, infusion tubes, and metal instruments for surgery as specified by your medical facility to avoid infection outside the facility and environmental pollution.

Symbols and standards

Symbols

	CAUTION The caution statements in this manual identify conditions or practices that could result in damage to the equipment or other property, or loss of data.
	Type BF-Indicates this is a product with Type BF applied parts. The device is complying with IEC 60601-1:2005.
	Operating Instructions for Use.
	Mandatory - Consult Directions for Use
	Manufacturer
	Date of Manufacture
	CE-mark Note: Minimum height of CE is 5mm.
	Non-ionizing electromagnetic radiation
	The identification number assigned by the Federal Communication Commission 2AFB3M-DSC300
	Certification for Taiwan NCC ID: CCAJ19LP7630T2
	HDMI (High Definition Multimedia Interface) Confirmation Number: ST-19-039
	European Authorized Representative
	Catalogue Number
	Global Trade Item Number

LOT	Lot number
SN	Serial Number
	GS1 Data Matrix
R_X ONLY	Medical Prescription only
	Direct current
	Recycling lithium-ion batteries
	Specific Battery Recycling
	Disposal of noncontaminated electrical and electronic equipment
	This product had an internal rechargeable battery with a Class II power supply.

Standards

Electrical safety	IEC 60601-1:2005+A1:2012 (EN 60601-1:2006+A1:2013)
EMC and regulatory compliance	IEC 60601-1-2:2014 (EN 60601-1-2:2015)
Ophthalmic instruments-Fundamental requirements and test methods Part 2: Light hazard protection	ISO 15004-2:2007
Ophthalmic instruments - Fundamental requirements and test methods - Part 1: General requirements applica-ble to all ophthalmic instruments	ISO 15004-1:2006
General radio compliance	Federal Communications Commission (FCC) Innovation, Science and Economic Development Canada's (ISED) National Communications Commission (NCC)

- Equipment connected to the analog or digital interfaces must be certified according to the representative appropriate national standards (such as EN 60601-1 and IEC 60601-1). Furthermore, all configurations shall comply with the system standard IEC 60601-1. Anyone who connects additional equipment to the signal input part or signal output-part configures a medical system and is therefore responsible for the system complying with the requirements of the system standard IEC 60601-1. If in doubt, consult the technical service department of your local representative.

IC

Innovation, Science and Economic Development Canada
This device complies with Industry Canada licence-exempt RSS standard(s).
Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Innovation, Sciences et Développement économique Canada
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

NCC

第十二條
經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條
低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。
前項合法通信，指依電信法規定作業之無線電通信。
低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

SAR

The device is designed and tested to meet the applicable limits for radio frequency (RF) exposure established by the Federal Communications Commission (U.S.A.) Specific Absorption Rate; (SAR) refers to the rate at which the body absorbs RF energy.
The minimum allowable SAR distance is 5 mm, and the maximum allowable SAR limit is 4.0 W/kg, averaged over 10 gram of tissue for the device. The following SAR values were measured during product certification, 1.060 W/kg with a (0mm gap) a value well below the maximum allowable limit of 4.0 W/kg.

L'appareil est conçu et testé pour respecter les limites applicables aux fréquences radio (RF) exposition établie par la Federal Communications Commission (États-Unis).
Taux d'absorption; (SAR) fait référence à la vitesse à laquelle le corps absorbe de l'énergie RF.
La distance DAS minimale autorisée est de 5 mm et la limite DAS maximale admissible est de 4,0 W / kg, avec une moyenne de 10 grammes de tissu pour le périphérique. Les valeurs de DAS suivantes ont été mesurées lors de la certification du produit, à 1,060 W / kg avec un (écart de 0 mm), une valeur bien inférieure à la limite maximale autorisée de 4,0 W / kg.

EMC (Electromagnetic Compatibility)

The device complies with the International Electrotechnical Commission standards (IEC 60601-1-2: 2014) for electromagnetic compatibility as listed in the tables below. Follow the guidance in the tables for use of the device in a Professional Healthcare Environment.

EMC (IEC 60601-1-2: 2014)

Guidance and manufacturer's declaration - electromagnetic emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emissions Test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A *1	
Voltage fluctuations/ Flicker emissions IEC 61000-3-3	*2	

*1 For the regions where the rated voltage is 220 V or greater, this device complies with class A. For the regions where the rated voltage is 127 V or less, this standard is not applicable.

*2 For the regions where the rated voltage is 220 V or greater, this device complies with this standard.
For the regions where the rated voltage is 127 V or less, this standard is not applicable.

Guidance and manufacturer's declaration - electromagnetic immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic Discharge (ESD) IEC 61000-4-2	±8 kV contact ±2, 4, 8, 15 kV air	±8 kV contact ±2, 4, 8, 15 kV air	Floor should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±0.5, 1 kV line(s) to line(s); ±0.5, 1, 2 kV Line to ground	±0.5, 1 kV line(s) to line(s); ±0.5, 1, 2 kV Line to ground	Mains power quality should be that of a typical commercial or hospital environment.
Voltage, dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	0% U_T for 0.5 cycle (1 phase) 0% U_T for 1 cycles 70% U_T for 25/30 cycles (50/60 Hz) 0% U_T for 250/300 cycles (50/60Hz)	0% U_T for 0.5 cycle (1 phase) 0% U_T for 1 cycles 70% U_T for 25/30 cycles (50/60 Hz) 0% U_T for 250/300 cycles (50/60Hz)	Mains power quality should be that of a typical commercial or hospital environment. If the user of the device requires continued operation during power mains interruptions, it is recommended that the device be powered from an uninterruptible power supply or a battery.
Power frequency (50 or 60 Hz) magnetic field IEC 61000-4-8	30 A/m (50 or 60 Hz)	30 A/m at 50 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE: U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted RF IEC 61000-4-6	3 Vrms at 0.15 – 80 MHz & 6V at ISM Frequency	3 Vrms (V1=3) at 0.15 – 80 MHz & 6V at ISM Frequency	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $E = \frac{6}{d}\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.7 GHz 80% AM at 1kHz	3 V/m (E1=3) 80 MHz to 2.7 GHz 80% AM at 1kHz	where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a] should be less than the compliance level in each frequency range[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above 3V/m., the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the device.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Test specifications for enclosure port immunity to RF wireless communications equipment						
Test frequency (MHz)	Band[a] MHz	Service[a]	Modulation[b]	Maximum power (W)	Distance (m)	Immunity test level (V/m)
385	380-390	TETRA400	Pulse modulation[b] 18 Hz	1.8	0.3	27
450	430-470	GMRS460, FRS460	FM[c] ±5kHz deviation 1 kHz sine	2	0.3	28
710	704 -787	LTE band 13,17	Pulse modulation[b]	0.2	0.3	9

Test specifications for enclosure port immunity to RF wireless communications equipment						
745			217 Hz			
780						
810	800-960	GSM 800/900, TETRA800, i DEN 820, CDMA 850, LTE Band 5	Pulse modulation[b] 18 Hz	2	0.3	28
870						
930						
1720	1700-1990	GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1,3,4,25; UMTS	Pulse modulation[b] 217 Hz	2	0.3	28
1845						
970						
2450	2400-2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse modulation[b] 217 Hz	2	0.3	28
5240	5100-5800	WLAN 802.11 a/ n	Pulse modulation[b] 217 Hz	0.2	0.3	9
5500						
5785						

[a] For some services, only the uplink frequencies are included.
[b] The carrier shall be modulated using a 50 percent duty cycle square wave signal.
[c] As an alternative to FM modulation, 50 percent pulse modulation at 18 Hz may be used because while it does not represent actual modulation, it would be worst case.

WARNING Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

The minimum separation distance for higher immunity test levels shall be calculated using the followin equation: $E = \frac{6}{d}\sqrt{P}$, where P is the maximum power in watts (W),d is the minimum separation distance in meters [m],

and Fis the immunity test level in V/m.

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EC REP

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